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OF THE

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

FOR

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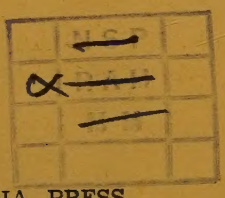

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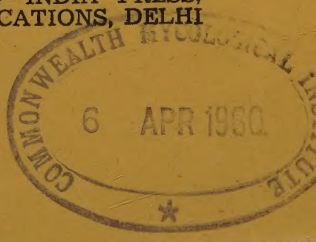

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SUMMARY

This is the 27th annual report of the Indian Council of Agricultural Research, giving a general review of the activities of the Council during the year 1956-57.

There were certain changes in the personnel of the Council during the year: Dr. R. J. Kalamkar was appointed as Additional Agricultural Commissioner with the Government of India and Dr. Sham Singh was appointed as Deputy Agricultural Commissioner (Fruit Development).

Eighty-six meetings of various Committees etc., of the Council were held during the year.

The Indian Council of Agricultural Research sanctioned the continuation of 61 current schemes at a cost of Rs. 29·73 lakhs. One hundred and twenty-two new schemes for research in agriculture, animal husbandry and statistics, involving an expenditure of Rs. 73·12 lakhs, were also sanctioned.

In addition to its activities relating to research in agriculture and animal husbandry, the highlight of the Council's activities during the year was its attempt to implement the recommendations of the Joint Indo-American Team envisaging a revolutionary change in agricultural education. One of the main deficiencies pointed out by the Joint Team was the shortage of persons trained in the technique of animal husbandry. In order to remedy this, steps have been taken to start two-year emergency courses and run double shifts in veterinary colleges. The two-year emergency course in veterinary science was started at nine Centres and short-term refresher courses in bacteriology, anatomy and survey were arranged at the I.V.R.I., and Bengal Veterinary College.

The second Conference of the Indian Council of Agricultural Education was held at Lucknow in September, 1956. The Conference discussed steps to improve and expand the scope of agricultural and veterinary education in India. The Conference also discussed ways and means to improve the conditions of the existing educational institutions.

The Council has launched a publicity programme aiming at wide dissemination of up-to-date information and methods of progressive farming to the cultivator in the field. A large number of pamphlets, bulletins and books on agricultural and veterinary subjects were issued in addition to the normal publication of its journals.

Though the Council started organising exhibitions comparatively recently, these have proved immensely popular. The Council participated in three exhibitions during the year; (i) the Khadi and Village Industries Exhibition, Indore (ii) All India Cattle Show, Indore and (iii) Agricultural Exhibition organised by the Farmers' Forum held in New Delhi. The Council has been receiving a number of invitations from Indian States and abroad for organising exhibitions.

The Indian Council of Agricultural Research secured the services of Dr. R. R. Shaw, an eminent library consultant of the U.S.A., to make a survey of existing facilities in libraries of various agricultural and veterinary institutions and to recommend measures to improve them.

A brief account of the research activities carried out in the fields of agriculture, animal husbandry and statistics is given below.

Agriculture

Rice : Extensive work has been done on this important cereal crop in the field of hybridisation, agronomic practices and resistance to diseases and pests. At the C.R.R.I., Cuttack, work on 63 combinations of hybrid varieties has been completed. Schemes for inducing salt and flood resistance in Bengal have terminated successfully; measures were undertaken for the improvement of *Boro* paddy. In the South, where the crop was generally affected by insects and fungi, breeding work was carried out with a view to produce resistant strains. Folidol 0·025 per cent spray gave adequate control against *Schenobius incertullus*. In Bombay, the fungus *Piricularia oryzeai* was found to be the causative organism for blast disease, while in Madras the disease was initiated by the stem-rot fungus. In both the cases, the growth of the fungus in the soil was inhibited by drenching the ground with solutions of various insecticides.

Wheat : At Mahabaleshwar, Benubbin 48, Dundee 48 and Kolben 11, CD 386 were tested for rust resistance. The largest number of uniformly rust-resistant cultures was obtained from Gaza and Gulab, in the F_7 generation. Work along similar lines was also continued at Niphad, Hyderabad, Kanpur and in Rajasthan. At the I.A.R.I., nine exotic varieties were tested against individual races of black rust. Samples of wheat were also chemically analysed at this Institute for their nutritive value.

Barley: Research work on the resistance to the attack of smut formed an important part in the study of this crop. Attempts have been made to combine resistance in the crosses with better yielding capacity.

Millets : As in other cereal crops, investigations on millets also included both the production of quality crops as well as resistance to various diseases.

Maize : Studies were conducted both on the Indian varieties of the corn and exotic varieties imported from Brazil. The work on hybrid maize was continued. A large number of plants were selfed for continuing the inbred lines.

Pulses : Pest control schemes were organised in Nagpur for Bengal gram. Manurial trials and investigations for producing wilt-resistant strains of *arhar* were continued in Bengal. At Berhampore, new strains of lentil were evolved. In West Bengal and the Punjab, studies were undertaken on various other pulses like *urid, moong* etc. Problems connected with *lathyrus* was given attention in various States.

Pasture-land and fodder grasses : In Saurashtra, Delhi, West Bengal, Andhra and Bihar, extensive surveys were made of the

available land for fodder production. The sites were further divided into soil types according to the nature of the grasses grown in these areas. Schemes for the improvement of pasture grasses and legumes were launched in Bombay and manurial and varietal trials were conducted. Fodder production also received attention in Coorg and Bhopal.

Tuber crops: Varietal and agronomical trials were attempted on tuber crops ; potato, *Colocasta, Ipomoea, Curcuma,* etc., received special attention.

To effect improvement in vegetables, various investigations relating to varietal tests, cultural practices, hybridisation and breeding for better and disease resistant types, were carried out in the Punjab, Himachal Pradesh, Uttar Pradesh, Andhra, Bombay Madras and West Bengal. Tomato, brinjal, *bhindi,* cauliflower, cabbage, mango, citrus and banana are a few of the many vegetables and fruits on which investigations were undertaken. Preservation and storage of fruits by the use of hormones and chemicals was attempted in Mysore, Poona and Kulu. In addition to these, all-India Fruit Shows were successfully organised.

Special attention was given to the improvement in cultivation and production of cashewnut and spices; schemes to extend the area under these crops were also sanctioned.

Agricultural Implements

An all-India survey of indigenous agricultural implements has been completed in almost all the States. The Council has sanctioned a scheme for the award of prizes for effecting improvements in 15 selected agricultural implements.

Soil Science

Schemes were launched to examine the existing methods of soil analysis and to select or evolve a method best suited to Indian conditions. The availability of the micro-nutrients was investigated; surveys of the microflora of soils were undertaken in Bombay and Mysore. Reclamation of saline and alkali lands was attempted in Andhra with considerable success.

Agronomy

Extensive manurial trials were carried on with various nitrogenous and other fertilizers on important cereal crops; these included trials on the cultivators' fields. The correlation between soil constituents and manurial responses were also studied.

Animal Husbandry

Several schemes were in operation to produce better breeds of animals by scientific breeding and also to improve the milking capacity of cows in various parts of the country. Effects of hormones on lactation were also studied in Southern regions, Himachal Pradesh, Kashmir and other parts of India; work on the sheep breeding schemes was carried out on a large scale. Programmes were formulated for selective breeding and their production of quality wool.

The scheme to study the influence of trace elements on the health and productive capacity of livestock in India and investigations on the diseases of cattle, sheep, goats and poultry continued to be carried out in the States and at the I.V.R.I. Different chemotherapeutic agents were tried with varying results to combat the attacks of disease organisms. Work on the control of rinderpest was also continued. Dairy problems under investigation included storage and marketing of milk.

Statistics

The Statistical Branch continued its work relating to the design of agricultural and animal husbandry experiments and examination of technical programmes. A large number of references from the F.A.O. of the United Nations, Central Governments and the State Governments were attended to. Post-graduate training classes were continued. A special refresher course for senior animal husbandry officers responsible for planning and guiding research in the field of animal husbandry in the States and Central Institutes was conducted. The training of the primary reporting agencies by officers trained last year was in progress in various States under the supervision of a statistical officer of the Council. Surveys of fertiliser practices in Andhra, Madras and Kerala were completed. Fertilisation demonstration trials with regard to nitrate applications and the scheme of National Index of Field Experiments were continued.

ANNUAL REPORT OF THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH
(1956–57)

CHAPTER I

ADMINISTRATION

General

This is the 27th Annual Report of the Indian Council of Agricultural Research presented by its Governing Body, under rule 64 of the Rules of the Council, giving a general review of the activities of the Council during the year 1956-57.

Changes

During the period under report, Shri P. N. Nanda, Animal Husbandry Commissioner with the Government of India, retired from service.

Dr. R. J. Kalamkar was appointed as Additional Agricultural Commissioner with the Government of India.

The following additional appointments were made:

Dr. Sham Singh—Deputy Agricultural Commissioner (Fruit development), Shri M. L. Chatrath—Under Secretary, and Shri P. G. Salvi—Under Secretary.

Finance and Accounts

The Council which influences agricultural research in co-operation with States, Universities and private institutions, sanctioned the continuance of 61 current schemes at a cost of Rs. 29.73 lakhs (Appendix II). During the year it also sanctioned 122 new schemes for research in agriculture, animal husbandry and statistics etc. involving a total cost Rs. 73.12 lakhs (Appendix III). Thirty-five schemes terminated during the year (Appendix IV).

The following were the receipts from: (i) The cess levied under the Agricultural Produce Cess Act, 1940 (ii) the grants received from the Government of India and (iii) grants from other sources:

	Rs.
I. Receipts from the Cess	43,27,790
II. Grants from the Government of India.	
1. Setting up of an Exhibition Unit in the I.C.A.R.	40,000
2. Supply of agricultural information literature to village level workers	6,00,000
3. Scheme for ascertaining the cost of milk production	64,000
4. Study of milk yields, breeds and management practices of bovines in the Northern Region of India	64,000
5. Scheme for research-*cum*-extension and bee keeping industry	9,540
6. Organisation of non-agricultural publicity with the assistance of Ford Foundation	19,925

	Rs.
7. Research on pepper and cashewnut etc.	49,000
8. Co-ordinated Cattle Sterility Scheme	31,000
9. Sample Survey for the estimation of area and yield of pepper	30,000
10. Manurial and agronomic trials	6,90,000
11. Rinderpest Eradication Scheme, preparation of propaganda material	10,000
III. Grants from other sources	
1. Contribution from States for 'Co-operative Film Production Unit'.—	
(i) Assam	30,000
(ii) Himachal Pradesh	15,000
(iii) Travancore-Cochin, (now Kerala)	30,000
(iv) Orissa	30,000
(v) Punjab	30,000
2. Contribution from Constituent States—	
(i) Kashmir	5,000

A statement showing the audited accounts of the Council for 1955-56 is appended (Appendix XIII).

Meetings

Eighty-six meetings of the various bodies of the Indian Council of Agricultural Research were held during the year 1956-57 (Appendix I).

CHAPTER II

AGRICULTURAL RESEARCH

Botany and Plant Physiology

At the I.A.R.I., New Delhi, a collection of 859 samples of seeds, cultivated as well as wild, was made from within the country. Among the former, some varieties of Bajra (*P. typhoides*) from Badayun district of U.P., cauliflowers from Faizabad and Bareilly in U.P., and musk melons were collected. During the year, 1861 plant materials were received from abroad. Important among these were wheats, oat, sorghum, tomato, soyabean, cowpeas, watermelon, muskmelon, essential oils and grasses.

At the Vivekanand Laboratory, Almora, besides 6 legumes tried in the previous year 8 new legumes belonging to the general *Lotus* and *Medicago* were introduced and seedlings raised. Seed of lovegrass, cuttings of giant star grass and Kundzu vine, Ladino clover and alfalfa have been distributed to various places in the Community Project areas.

At Indore, activities of dehydrogenases, Peroxidase, Catalase, Phosphoxylase, Phosphatases, Amylase and Esterase were investigated. Both bio-chemical and cyto-chemical studies on these enzymes were done.

At the Vivekanand Laboratory, detailed experiments were undertaken to study the effect of different phenoxy-compounds on growth and germination of pollen-grains of crop plants and to find out germinating media for optimum growth elongation of different pollen-grains. Maximum length of pollen-tube so far observed was 2,960 microns in pollen of maize Inbred 12. Since the lengths of silk of maize through which the pollen-tube has to grow to reach the ovules are sometimes more than 40 cms. long, experiments are in progress to discover a medium in which the lengths of the pollen tubes would approach what obtains *in vivo*. Effects of incorporating micro-concentrations of calcium nitrate/potassium nitrate, boron, manganese and molybdenum in germinating medium were studied in the case of wheat. The effect of puncturing pollen tubes with micro-needles under high magnification of an ultramicroscope was studied. It was noted that in all cases the flow of protoplasm content was continuous and without any bead formation.

Cytological studies on seven varieties of maize *viz.*, Punjab 68-66, Kulu Sathoo sample 2, Nagrota local late crop, Kalimpong white round, Hyderabad 411, Hyderabad 420 and Hyderabad 446 included data on chiasma frequency and terminalization coefficient. Cytological work was also done on *Coix aquatica*, *C. lachryma jobi*, *C. gigantea*, *Chionachna Koenigii*, *Veteiveria zizanioides* and *Imperata cylindrica*. Attempts to induce polyploidy in *Coix aquatica* and *C. lachryma jobi* were made.

From the results of preliminary experiments at Poona, it was decided to try Dicotox—a synthetic product containing the selective

hormone 2, 4-D for seed treatment. Three concentrations of the hormone together with check, different levels of N, P, K, and their combinations, irrigation and no-irrigation were the various factors whose influences were studied on groundnut, *Kharif jowar, Rabi jowar,* wheat and gram. Seed treatments invariably resulted in early germination, increase in tillers and greater vigour in plants compared to the untreated control. Generally, there was no significant increase in yield due to hormonal treatment. However, in the case of unirrigated wheat in bigger plots at Bagalkot, seed treatment was found to be statistically significant. Contrary to the findings of preliminary trials, water treatment of groundnut decreased the yield. In *Kharif jowar,* 0·1 p.p.m. of the hormone in combination with 40 lb. N. per acre gave increased yield. This effect was not seen in *Rabi jowar.* Gram treated with 0·001 p.p.m. of the hormone both without manure and without irrigation gave higher yield compared to untreated seed receiving N, P, or K.

At Calcutta, physiological studies of rice plant in relation to nutrient deficiency showed symptoms induced by K-deficiency by the dull-green colour of the rolled leaf apex, and P-deficiency by the prominence of dull-green colour of the leaf apex, incomplete ear-emergence and black spotting of grains. While by Ca-deficiency, progressive death and reddish appearance of the leaves, the green leaves showing wilting signs during sunny days, and late flowering were the prominent features. Height and tillering in deficient leaves were inferior to control plants but no significant difference was observed in the time of leaf unfoldment. Reduced yield was prominent in K-deficient plants, while in other deficient series, yield was not affected by the levels of nutrient supplied. In early stages of the life cycle, protein nitrogen is reduced in the deficiency of K and P but at the latter stage, *i.e.,* at the 13th leaf stage, protein nitrogen is more or less the same as that of the control.

In Delhi University, studies on storage and viability of pollen grains and physiology of pollen-tube growth were taken up : at 5° to 8°C. The pollen of *Solanum tuberosum* (potato) var. *Phulwa* remained viable for 70 days over 40 per cent R.H., 59 days over 0 per cent R.H. and 44 days over 66 per cent R.H. Those of *Brassica nigra* (T 257) retained viability for 55 days over 40 per cent R.H., 48 days over 0 per cent R.H. and 41 days over 66 per cent R.H. The pollen grains of *Arachis hypogea* (TMV 1,115) remained viable for 15 days over 40 per cent and 60 per cent R. H. at 3°C. With the addition of 0·01 per cent boric acid, high percentages of germination and appreciably long tubes were obtained in culture medium containing different concentrations of sucrose, dextrose, raffinose, galactose or lactose. Observations in this respect were made on *Solanum tuberosum* var. *Phulwa Brassica nigra, Solanum melongena, Gossypium herbaceum* and *Pennisetum typhoideum.*

Anatomical changes of the stem apex of winter variety of paddy 'Rupsail' during its transition from vegetative flowering stage were examined in detail at Calcutta University. Different photoperiods were applied and the changes from vegetative growth to reproduction with transitional stages were studied. It was noted that flowering initiation and development takes place in four stages. These four phases starting from changes in the dimensions of the apex at the end of the first week to the complete differentiation of parts as glumes, stamens and carpels take three weeks' time.

At Delhi University, when *Mangifera indica* (mango) was treated with 0·001 per cent spray of ICA, there was some indication of proliferation of cells of the inner layers of the seed coat. Experiments were also conducted on *Petunia* and *Argemone* to study the influence or hormones on fertilized ovaries. Work was also done on induced parthenocarpy, though yet at a preliminary level. Along with fruit growth, seed development was also observed in *Carica*, *Papaver*, *Nicotiana*, *Datura* and sometimes in *Luffa and* Lagenaria, but in all these cases the growth of the seed coat was not accompanied by embryo or endosperm development.

Rice (*Oryza sativa L.*)

Inter-specific hybridization

At C. R. R. I., Cuttack, out of a balance of 68 cross combinations to be completed under the extended programme of hybridization, 63 were completed during this year. A total number of 20,489 cross pollinations was attempted during this year and 2,200 crossed seeds were obtained; the crossed seeds were rather badly shrivelled due to unfavourable weather conditions. F_1 generation consisting of 700 plants from 60 cross combinations were raised and studied. Approximately 81,927 seeds for growing F_2 generation were distributed to the participating States. F_3, F_4 and F_5 generations of several cross combinations were studied and 195 selections from F_3, 227 selections from F_4 and 175 from F_5 were carried forward.

In West Bengal, out of eleven sets of *Japonica* × *Indica* crosses 76 single plant selections from F_4 generations were made. Two sets of crosses, CNAB-4 (Chinese) × Jasuda or Dorakhay (Local), and Adday (local) × Khalemasino were attempted in order to improve the yield and grain quality. The latter proved successful.

Breeding for salt and flood resistance

In West Bengal, 566 types, including the selections from last year, were grown under transplanted conditions in flood affected areas. Three hundred and seventy-seven out of these were sown under broadcast conditions at Satni for study and selection. At Gushkara, 152 types were grown under three situations, *i.e.*, where water level rose up to 2 ft., 4 ft., and above 4 ft. Detailed agro-botanical notes were taken and selections of promising types were made. In saline areas, 1,415 types including 86 lines from last year were grown in moderately saline areas and 1,130 types in very saline areas at Gosoba for isolation of pure lines. At Contai, 350 types from Gosaba were grown under very saline and saline (soil under reclamation) situations. Only 8 plants survived.

In the three preliminary trials at Gosaba (in the early group) *Bheral* (Type No. 55-9) topped the list in grain yield, giving 3826.50 lb. per acre and *Lalgenti* (55-149) in straw yield giving 4833·71 lb. per acre. In the medium group, *Sadamota* (55-210) gave the highest grain yield of 3576. 76 lb. per acre and *Patharkuchi* (55-39) for the highest straw yield of 4899·03 lb. per acre. In the late group. Talmugur (55-255) topped the list in grain yield giving 3672·60 lb. per acre and was at par with *Kumargore* (55-231) giving 3581.31 lb. per acre and in straw yield Tilakkachary gave the highest yield of

5503·46 lb. per acre and was at par with *Kumargore* (55-231) which gave a yield of 4906·76 lb. straw per acre. Last year *Kumargore* topped the list in grain yield, giving 3351.34 lb. per acre. In a varietal trial with nine types, *Patani* 23 topped the list in grain yield giving 3281 lb. per acre and was followed by *Talmugur* and *Patani* giving 3201·42 lb. and 4051·30 lb. per acre respectively. *Kumargore* yielded 2329·66 lb. per acre. In straw yield, *Patani* 23 topped the list, giving 15090·64 lb. per acre followed by *Talmugur* which gave 12003·20 lb. per acre.

In Assam, the variety *Neghri Bao* was tried for three years and found to be highly resistant to flood. This was released as a flood resistant variety. Breeding work was carried out to combine flood resistance with high yield. F_2 seeds of cross between *Laudumra* and *Gent* grew well and some plants were selected for growing as F_3 next year.

Improvement of Boro paddy in West Bengal

A preliminary trial with 28 promising varieties was conducted at the Agricultural Research Station, Chinsurah (Hooghly). Among these, ten varieties were introduced this year from pure lines, replacing those ten which did not give good yield during the last two years. This year C. O. 13 gave the highest yield of 27·47 maunds of grain per acre and was statistically at par with Chinsurah Boro No. 1, CH 45, Borosati and Bhogjira-II which yielded 27·14, 24·99, 23·66 and 23·00 maunds per acre respectively.

This year, results of varietal trial showed that Tepa I gave the highest yield of grain (26·44 md.) followed closely by Chinsurah Boro No. 2, Tepa-II and Chinsurah Boro No. 1. Among the *aus* varieties grown during *boro* season *Bhutmuri* was found to give best yield, *i.e.*, 22·56 maunds per acre.

Improvement of high altitude paddy

Paddy collections and pure lines were maintained at Kalimpong and Darjeeling. Ninety-three selections were tested in two progeny row trials against local and some of them were found to be fairly high yielding. A varietal trial with eight varieties selected mostly from local varieties, including one Chinese type, was taken up. Two of them, namely *Champasari* and CNAB-4 (Chinese) though not superior to the best local *Ramtulasi* were found superior to the rest.

Breeding for insect and disease resistance

In Coorg, there were 202 varieties in the collections ; varieties from Mysore, Hyderabad, Madras and Thailand were also introduced. Two varieties, *viz.*, Andrew-Sail and B.A.M. 3, because of their good performances in yield, resistance to diseases and pests and grain colour, were released. A search for varieties of Japonica-Indica crosses suitable to Coorg conditions was continued.

Insect pests of paddy

The paddy Agromyzid fly was observed ruining paddy leaves in Andhra during 1952-53 for the first time in India. A survey was conducted in 28 villages representing four main rice-growing districts

of the State and the pest was found in all the villages. It has been identified as *Pseudonapomyza atra* Meigen. Fortnightly observations were taken on selected plots in cultivators' fields in two villages each in Nizamabad, Hyderabad and Nalgonda districts from July to October. The larval and pupal stages of the fly were described and the nature of mine formed was studied. Two pupal parasites were also reared.

Stem borer (Schenobius incertullus)—In Madras, six varieties of paddy, ADT. 1, ADT. 2, ADT. 8, ADT. 25, CO 19 and CO 25, were tried for susceptibility to the attack of stem borer, and the incidence of attack by sowing at weekly intervals. The trials indicated that all the varieties were susceptible to the stem-borer attack. It was also found that mechanical removal of egg-masses lowers the incidence of the pest. Spraying Folidol 0·025 per cent or Endrin 10 c.c. in one gallon kept down the incidence of the pest. From the point of view of yield and keeping down the incidence, Folidol 0·025 per cent spray seemed to be the best.

In Hyderabad, an experiment was laid out with varieties HR 12, HR 19, HR 67, RDR 2, RDR 7 and CH 45. At the time of the harvest, lowest number of bored heads was observed in CH 45 followed by RDR 7. In grain yield, CH 45 was the lowest and the difference was statistically significant. It was observed that the sowings done during the third and fourth week of January yielded the highest. Mechanical removal of the egg-masses was also done and the periodical observations pointed out that there was nearly 40 per cent reduction in the number of affected ear-heads at harvest in the treated plots. The grain yield also was greater in the treated plots. Periodical observations indicated the superiority of spraying with insecticides over the control. In general, spraying with Folidol at 12 c.c. per gallon of water was slightly superior to the other treatments.

In West Bengal, an experiment was conducted to note the susceptibility of eight popular varieties of *Aman* paddy to stem borer (*S. incertullus*). No variety was resistant to the attack of this pest. An experiment was also conducted to note the effect of four dates of sowing with *Aman* paddy. It was established that sowing of *Aman* paddy up to 15th June prevents the infestation of this pest partially. The varietal difference had no significance to this. Experiments were also conducted with two insecticides—Parathion and Endrin—to note their effect in the control of this pest. It was found that there was significant difference amongst the treatments proving thereby that the application of insecticides as prophylactic measure has a direct value on the protection of the paddy crop.

Diseases of paddy

In Bombay in 1954-55, 16 isolates of the fungus *Piricularia oryzeai* Cac. causing blast disease of rice were obtained and tested for their sporulation. During 1955-56, work on the parasitism of only eight of the 16 isolates was taken up due to inadequate glass-house facilities at Poona. These isolates were tested individually on 22 paddy varieties. Marked differences in respect of virulence were observed amongst the isolates, which could be broadly grouped as virulent, intermediate and weak.

In Madras the causal organism of stem-rot disease of rice, *sclerotium oryzeae* was isolated from diseased paddy specimens from six different places, *viz.*, Cuddalore, Vellore, Tanjore, Tiruchirapalli Coimbatore and Mangalore. Morphologically, they were all like, excepting the Tiruchirappalli isolates which had smaller and darker sclerotia. Study of the varying levels of soil moisture revealed that 35 per cent soil moisture is about the optimum for the growth of the fungus. Field experiments showed that there was hardly any difference in the intensity of infection in the plots where insects were controlled by insecticidal dustings and where the insects were left un-controlled. Growth of the fungus in the soil was inhibited by drenching the soil with 0·1 per cent solutions of Orthocide 50, wet Cerasan Leytosal and 1 per cent solution of lime ; lower strengths of these solutions could not only retard the growth.

Wheat (*Triticum* sp.)

Trials of varieties and progenies for rust resistance

At Mahabaleshwar, only three exotic wheat varieties were received for testing. They were Benkubbin 48, Dundee 48 and extra Kolben II CD 3826. All of these were either highly or moderately resistant to races 15, 21, 34, 40, 42, 42B and 117. Varieties N. P. 792, 797, 798, 799 and 809 were semi-resistant to moderately susceptible in the field with infection of different types. Like last year, these were intermediately or highly susceptible to race 42B which was of common occurrence in Bombay State during the year. Kenphad 21, 25, 28 and 34, KCN 179 and MHD 177 and 145 were tested at the Sugarcane Research Station, Padegaon also. The weight of 1000 grains in respect to the rust attack was studied. Again, progenies of 1,448 hybrid selections in F_3 to F_{10} and about 3,800 plants of 19 crosses in F_2 were tested in the field against a mixture of ten races of stem-rust, *viz.*, races 15, 21, 24, 34, 40, 42, 42B, 75, 117 and 194. The largest number of uniformly rust-resistant cultures was from Gaza × Gulab in F_7, in which 40 out of 68 cultures were highly resistant or semi-resistant. Twelve cultures (seven from Gaza × Baxi in F_7 to F_9; three from Gaza × Motia in F_7 and F_8 and two from Gaza × Jay, also in F_7 and F_8) were found to be uniformly resistant in the field as well as in the seedling tests in the glasshouse and were also reported to be good in agronomic characters like yield, grain size, lustre, etc. Five of them proved even superior to Jay and Vijaya at Niphad. In the Bombay section of this scheme the largest number of highly or moderately resistant cultures was obtained in F_3 and F_4 from the crosses St. 88 (N. P. 790) and the other different rust susceptible varieties. Eighty-eight out of 234 cultures from such crosses were uniformly rust resistant. The cross HY 5-7-2 × HY 278 in F_5 yielded 22 highly resistant cultures out of 91. The promising crosses in F_6 to F_8 were ED: 58 × Ex. 130 (Gaza) HY 278-4-1-1-× Hy. 65-5 and Ex. 130 × N. 168.

At Niphad, the varietal collection of improved strains (both indigenous and exotic), of different types and genera were maintained pure and some of them were used for hybridisation work. Thirty straight crosses, four back-crosses, thirty-two out-crosses and there multiple crosses were made with improved susceptible types to combine rust resistance from Gaza and Mexican types. Further work included growing of F_1 progeny, trials of selection in rodrows, selection

in progeny rows, yield trial on small plot basis, yield trials on large plot basis, secondary selections from Kenphad, testing against stem rust at Mahableshwar and Kopergaon (plains) and testing the promising cultures on district basis and on cultivators' fields.

In Hyderabad, seven N.P. wheats introduced from I.A.R.I., *viz.*, N.P. 710, 720, 721, 737, 758, 761 and 52 were tested for reaction to rust against PW 5 and the local variety. One series was raised under rainfed conditions and the other was irrigated three times at intervals of about one month. In the irrigated crop, intensity of rust was 0·1 per cent in N.P. wheats, except in N.P. 52 and N.P. 710 which were free from rust, and 5 to 10 per cent in local and PW 5. In the crop grown under rainfed conditions there was no rust. Also, five foreign varieties *viz.*, Charter, Gabo, Hofed, Kendee and Yalta and the three rust resistant selections of the Plant Pathologist, Rajendirnagar (Hymayatsagar), Hyderabad-Dn. *viz.*, K. G. 3-3, H. 2-1 and H 5-3, were tested against PW 5 and local in two series. The rust appeared on the irrigated crop of Yalta, local and PW 5 only, the intensity being 1 per cent in Yalta and less than 5 per cent in other two varieties.

A survey of the incidence and severity of different rusts of wheat and barley carried out in 20 districts of U.P. showed that yellow rust was most widespread and severe this year. Variety N.P. 52 was heavily affected by yellow and brown rusts at Baharaich and Barabanki. Desi Kathia and Pissi local varieties were severely affected by yellow rust at Banda and Jhansi. Variety Pb. 591 showed heavy incidence of yellow rusts in Dehradun, Moradabad, Nainital and Garhwal districts. Wheat C 13 was badly affected by yellow and brown rusts in Azamgarh, Hardoi, Lucknow and Barabanki. Varieties K 53 and K 54 showed moderate infection of yellow rust. Variety Kuppa showed moderate infection of black rust in Jhansi district. Variety N.P. 710 was highly affected with yellow and brown rusts at Baharaich and Banaras and moderately with yellow rust at Meerut, Nagina. Saharanpur and Barabanki. Variety N.P. 796 (at Nagina) and N.P. 809 (at Meerut) were found most tolerant to all the three rusts under field conditions.

Detailed observations on different resistance trials conducted at Bahraich, Kanpur and Meerut were made. Thus varieties N.P. 792, 797, 798, 799, 803, 809, 813, MP Hy 65, Ridley, Pb 8A and Pb 409 proved resistant to black rust at Baharaich. Varieties N.P. 165, 792, 797, 798, 799, 803, 809 813, MP Hy 65, Ridley, Kathia white and BP 808 were resistant to black rust at Kanpur. Varieties N.P. 792, 797, 798, 799, 803, 809, 813, MP, Hy. 65, Ridley, Gaza and Padava II were resistant to black rust at Meerut. The nine varieties, *viz.*, N.P. 792, 797, 798, 799, 803, 809, 813, Ridley and MP. Hy. 65 were generally the best at the three above-mentioned places. Varieties N.P. 792, 797, 798, 799, 809, 813, and Aust 144 were in the best rust-resistant group for yellow rust, showing from 0 to below 5 per cent infection of the diseases at Baharaich. Fifteen varieties, *viz.*, N.P. 4, 771, 792, 797, 798, 799, 803, 809, 813, Ridely, Padava I, Padava II, Aust 144, Pb. 228 and E 1046 were generally the best at the three centres.

In Rajasthan, large-scale trials with N.P. varieties and other resistant varieties of Hyderabad were taken up. Also, the material

from the crosses that were made in Rajasthan and the crosses supplied from the I. A. R. I. New Delhi, were tested for rust resistance.

At the Indian Agricultural Research Institute, New Delhi, nine exotic wheats were tested in the seedling stage against individual races of black rust. Only one variety, *viz.*, E.C. 4613 (*T. monococcum*) was found to be resistant to all the races, including race 133. E. 1844 (Supremo × Montana) was found to be resistant to all except to races 34 and 40. The varieties E. 1844 and E.C. 4613 showed high degree of resistance to the virulent race 122. With a view to finding some resistant genotypes for the virulent race 122 of black rust, 39 foreign wheats were tested in seedling stage against that race. The varieties E. 572 (Ridley) E. 581 (Kenya 184 P. 2 A.I.F.) E8T 1 (Timstein in derivative), E. 1913 Kenyagular-Pilot×K 58—Newthateh, and E. 2025 (*Arabian durum*) showed high degree of resistance to this race. Out of 9 varieties of wheat tested against individual races of brown rust, only L. C. 4613 exhibited resistance to all the races. With a view to find out stocks resistant to the recently discovered brown rust race 77, nearly 22 wheat varieties were tested against that race. Varieties W. 160 (Montana), E 576 (Hofed), E 578 (Gabo), E. 617 (Frendoso×K.×G 8806), E. 688 (Sel 21×Move Escobar), E. 1847 (Supreme) E. 1912 (Timstein×Mida), E. 1915 (Timestein× Newthateh), E. 2143 (Tremer Molle), E. 2144 (Dickson's No. 444). E. 2285 (Timophesvi-Squarrosa amphidiploid×Newthateh), E. 2543 (Dawbul) and E. 2546 (Rio Negro×1788) were found to be resistant to this race.

At the I.A.R.I., the progenies of the crosses made during the previous years were tested and suitable selections made. Also, trials of strains resistant to different rusts (already evolved) were conducted at Delhi and Vijaypur (B.S.), Saurashtra (Aliabad, Mansur, Gobitwod, Junagarh, Mehuwa, Manavdar, Sardargarh and Pabyad). At Babhci N.P. 797 gave the highest yield of 627 lb. per acre under irrigated conditions, while under unirrigated conditions it was second to NP 718. At Dohad (B.S.) N.P. 797 again topped with an yield of 944 lb. per acre. Taking into consideration all the factors, N.P. 710 seemed to be well suited for general cultivation in Saurashtra. At the three centres, *viz.*, Bassi, Durgapur and Ganganagar, trials were laid out where N.P. 718 gave an yield of 1,768 lb., 1,561 lb., and 1,574 lb. respectively.

At Pusa, work was done for the incorporation of rust resistance from diverse sources in improved wheats adapted to Bihar conditions. Thus some primary, three-way crosses, double and back crosses were attempted. Trials were also conducted for resistance to black rust in N.P. wheats. N.P. 797 was free of all the three rusts. N.P. 788 and N.P. 789 were free of the yellow and the brown rust. Major wheat varietal trials were conducted with N.P. and local wheats at Pusa, South Bihar (one centre). Trials with some of the strains evolved at I.A.R.I. were carried out at Pusa centre both under irrigated and rainfed conditions.

At Indore centre, 48 crosses of *durum* and *vulgare* were attempted which included 12 primary crosses, 4 back crosses, 21 three-way and 11 double crosses. The progenies of 177 crosses in different generations comprising 72 *durum*, 78 *vulgare*, and 27 inter-specific crosses were subjected to artificial infection with a mixture of 11 races

and two sub-types of black rust. A large number of types of *durums* and *vulgares* comprising 317 *durums* (114 exotic and 203 indigenous) and 569 *vulgare* (267 exotic and 302 indigenous) were studied for their agronomic characters. E. C. 69, Malvilocal 5, Med. 510-59, C. P. D. 124-2-2, C.P.D. 134-6-2, Natakatha, A 624, Uj Pr. 7 and 25 Kathia and P.W.I. were found promising. Regional trials were also conducted in Madhya Bharat, Bundelkhand and Bhopal. At the Wellington centre, 41 selections were tested for resistance to races of black and brown rusts of these P.D. 13 and P.D. 14 only showed resistance to brown rust. All the accessions were free from black rust, except I. C. 1131 which was susceptible.

Trial of varieties for yield

In Hyderabad, it was observed that PW. 5 gave significantly higher yield than the local and N.P. wheats in the series, grown under rainfed conditions. In the irrigated series N.P. 718 gave slightly higher yield than the local and P.W. 5 but the differences were not significant. Among the N.P. varieties, N.P. 718 and 721 appeared promising. Four Kanphad varieties from Bombay State, viz., 17, 26, 34 and 39 and three Hyderabad varieties of M. P., viz., Nos. 5-7-2, 11-6, and 12-3-7 were tested against PW. 1, PW. 3, PM. 5, PW. 22 and local. It was seen that all the PW. varieties gave higher yields than all the imported ones, except Hy. 11-5 from Madhya Pradesh and Kanphad 26 from Bombay State.

In Orissa, among the new strains, N.P. 797 occupied the first position at Maudhasal and at C.R.R.I., Cuttack.

At the Simla centre of I.A.R.I., extensive areas in the North Indian hills were put under the improved hill wheats, viz., N.P. 770, 809 Ridley and N.P. 792. All the varieties withstood the heavy rust attack and gave a very good account of themselves in regard to yield and grain quality. Also, a comprehensive hybridization programme for the intensification of all the desired characters and rust resistance in N.P. 770, 809 and Ridley wheats was undertaken at this place.

Hybridisation

Hybridisation was carried out between the best indigenous types and exotic varieties at the I.A.R.I., New Delhi and Wellington. The progenies of the crosses made during the previous years were tested and suitable selections made.

Some 18 hybrids were obtained from last year's inter-specific crosses at Indore. A number of crosses in which D.G. 59 (advanced generation of durum × Gaza) was one of the parents showed high degrees of sterility. Three diploid species of *Agropyron* were used for crosses with *Triticum monococcum*; this also showed high degree of sterility with very few seeds. The chromosome number of diploid *Agropyron* sp. used for hybridisation has been confirmed from mitotic divisions as well as pollen-grain mitosis.

Chemistry

At the I.A.R.I., New Delhi, 84 samples comprising 14 varieties of wheat were analysed and data obtained on weight per 100 grains,

moisture, ash, insoluble ash, protein, calcium, phosphorus (total), phytin phosphorus, diastatic activity, free sugar present and niacin content for all the samples. It was found that the result of chemical analysis for different varieties of wheat were in close agreement with those reported last year.

Barley (*Hordeum vulgare*)

At the Simla centre (of I.A.R.I., New Delhi), 55 selections of six-rowed barley and 16 selections of two-rowed barley were included in a preliminary row-trial. Seventeen six-rowed barleys, mostly selections from the local samples, outyielded the existing controls, including B. 70. None of the two-rowed barleys could come up to the levels of the controls, though Harugani Brines and B. 253 approached them fairly closely. Of the 157 barleys tested for adult plant resistance to mixture of all the races of black and yellow rusts, only 27 were found to be free.

In Rajasthan, variety R.S. 17-3 yielded significantly higher than all, except Rs. S. 30-1. All the varieties from Simla *viz.*, B. 240, B 19, B 65, B 224 and B 161 gave very poor yield. R.S. 30-1 gave yields higher than that of K 12, N.P. 21, R.S. 17-5, P.I.T. 4, R.S. 30, R.S. 18, Amer. R.S. 1, local C-50, No. 21, No. 25, No. 7. R.S. 27, N.P. 13 and all Simla varieties. In manurial trials it was found that, with increase in the quantity of nitrogen fertiliser, there was a direct increase in the yield of the grain. It was observed that phosphorus had no effect on the yield of barley. Three new crosses were effected, the first between B 65×R.S. 17 to introduce very early maturity of B 65 and large tillering and yielding capacity of R.S. 17 (B 65 was also resistant to rust and smut under field conditions) ; the second between B 109 and R.S. 17 for introduction of good ear-length and smut resistance of B 109 in R.S. 17; and the third between B 240 and R.S. 17 (in which B 240 is two-rowed barley resistant to smut under field conditions).

Millets

Bajra (Pennisetum typhoides L.)

In the scheme for evolution of hybrid Cumbu (*bajra*) in Madras. two crops were raised for experimental purposes but the season was not quite favourable. Six hundred and thirty-one inbred lines were studied and desirable selections were further selfed. The pure seeds of the parents of promising hybrids were multiplied. A total number of 175 top crosses and 301 single crosses were effected. The seeds of the hybrids in final yield trials were multiplied by artificial pollination. Twenty-one of these top crosses were observed to give significant increases in yield over the inbred parent and tester. The inbreds varied much in their yielding capacity and the top cross performance was observed to be a satisfactory criterion for grading them accordingly to their combining ability. Among the single crosses, 63 showed significant increase in yield over the parents and the standards. Also, 13 hybrids of short duration were tested in yield trials under irrigated and rainfed conditions. Of these, 12 were significantly superior to the standard in the yield of grain in the summer season and nine gave superior yields under rainfed conditions. Considering the results of present trials and those of last few years, two hybrids, H. 442 and H. 866, were found suitable for being released to cultivators.

The short-duration hybrids H. 442, H. 863, H. 886, and H. 874 were tested in the ryots' fields along with local short-duration varieties in the districts of Salem, Coimbatore and Tirunelveli. These were superior to local varieties in all districts, but were considered best from the point of view of yield and duration.

A total quantity of 40,617 lb. of seeds of hybrids and improved strains was distributed for large scale cultivation and 4,630 lb. of seeds of parents were issued for seed farms.

In the scheme for investigation into smut disease of Bajra, survey of the incidence of smut of this millet was taken up in Gujrat, Saurashtra and Nasik district. Collection of smut spores was done from different localities and from different varieties of *bajra*. Optimum conditions for germination of chlamydospores and production of sporidia were also studied. Taxonomic study of different collections was done. Methods of perennation of the fungus from one season to other were also studied.

Jowar (Andropogon sorghum)

Under the scheme of control of *Striga* in Andhra, 42 resistant selections from the local *Sorghum* variety at Nandyal and 24 at Lam were tested. Selections A. S. 8194/1 and 31/1 were under trial for the third year. At Nandyal, 116 hybrid plants were spotted in the population raised from the crosses effected during the last season between N1, N2, N3 and A. S. 4003. At Lam, 50 hybrid plants were spotted from the population of G1 and G2 (crosses with A. S. 4003). All the hybrids were taken for raising F_2 population during the coming season.

Maize (*Zea mays*)

Introduction of exotic material to enrich the genetic stock

In Uttar Pradesh, 64 samples of corn were received from Brazil. Thirteen new samples, both extra and intra-provincial from Hyderabad, West Bengal, Jaunpur and Farrukhabad were added to the collection and studied in detail with regard to various characters. Three hundred and fifty-six cultures, together with the new samples, were studied in detail with regard to various characters in small unreplicated plots. These have been classified.

At the I.A.R.I., New Delhi, 72 exotic and 16 Indian varieties were added to the list. A total of 107 varieties were maintained by mass sibbing. In a yield trial of nine Indian and five South American varieties, Patiala local (3,016 lb. acre) topped the list. Fifty-two flint and dent inbreds from South and Central America were intorduced and maintained. To test the general combining ability, about 500 inbred lines in S_1 to S_4 were top crossed using Kanpur Type 41 and Amarille-de-Cuba as male tester parents. Also, yield trials with last year's top crosses and double crosses were conducted and good combining lines were retained for further trials.

Breeding

Besides inbreeding and isolation of inbred lines from unselected material, 2,600 plants representing the various inbred generations of

S_1 to S_6 were further selfed for carrying the lines to the next generation and raising the desirable homozygous lines. Two thousand five hundred and twenty-four selfed cobs were obtained from the above, out of which only 944 lines were retained for further inbreeding. In all, about 7,600 plants were hand-pollinated and 6,024 selfed cobs were obtained. This meant 79·3 per cent success in selfing maize under Kalianpur conditions. Out of the 55 top-crosses made in the year 1954-55, eight were discarded on account of very late maturity and poor vigour. The remaining 47 were tested in replicated trials at three centres—Kanpur, Raya Farm (Mathura) and Bahraich, along with three of the improved types and on local as control. At Raya Farm, the differences were highly significant, but none of the top crosses yielded significantly higher than T 41, though 14 of them gave numerically higher yields. Twenty of the top crosses were superior in yield to Raya Local, while the rest were of the same order. Ninety-eight S_1 lines (88 early and 10 late) and 60 of the promising S_1 lines (42 early and 18 late) were top-crossed with Meerut Yellow —an early improved type—and T 41, respectively, in two isolated plots. The resulting top crosses were to be tested in replicated trials at three centres during the *Kharif* 1956, for their general combining ability. The results are awaited.

In the Punjab, a beginning was made to produce hybrid seed of promising double crosses on a field-scale and over 7 maunds of hybrid seed of some of these double crosses was produced.

Out of 3,206 plants selfed last year, 971 of the best plants were selected and raised at Jullundur and Kulu (Punjab) for further purification. In all, 2,121 plants were subjected to further selfing, some of them now having been selfed for 10 to 11 successive generations. The inbred progencies raised at Jullundur were studied in detail for various economic characters to judge the extent of purity attained by them in successive generations of selfing. It was observed that, in respect of tasseling date, plant height and ear circumference, most of the lines had attained reasonable purity in early selfing generations, but with regard to other characters, the lines continued to exhibit considerable variation even in advanced selfing generations.

Out of over 60 inbred lines, which have attained purity in respect of the characters and which are now being maintained by sibbing, about 40 lines have been established to possess high general and specific combining ability. These lines have been derived from diverse sources and differ widely from one another in almost all the characters. Studies made in the inbred progenies raised at Jullundur for their reaction to stem-borer, which is becoming a menace to maize crop in the central districts of the Punjab, showed that most of the lines *viz.*, 651 out of 712 (92·83 per cent) were infested by borer, the incidence of attack in them ranging from 4·33 to 80 per cent. Out of 61 lines, which escaped borer attack, over one and a half dozen lines are now in advanced selfing generations and may thus serve as a valuable source of resistance in the breeding programme. In order to determine the general combining ability of the apparently homozygous inbred lines, 211 top crosses attempted last year were tested in replicated progeny row trials against locals at Jullundur and Kulu. Of these, as many as 40 top-crosses out-yielded the locals by significant margins ranging from 23·99 to 89·67 per cent.

These crosses were also studied for other economic characters and it was observed that in plant height, ear height, ear length and ear circumference these were better than the local. Many of them also exhibited lower incidence of borer attack, barren plants and lodging. Evidently, the inbred lines used as parents in these crosses can be considered to possess high, general combining ability. Fresh top-crosses numbering over 300 were also attempted for valuation of more inbred lines.

Single crosses, numbering 434 were under replicated progeny-row trials at Jullundur, Kulu and Mangwa. Of these, only 17 crosses gave significantly higher yields than the locals, kept as standards, by margins ranging from 27·69 to 61·23 per cent. These crosses, in addition, were superior in other economic characters. Most of the crosses, however, were slightly later in maturity than the locals.

About 10 promising single crosses, which gave good performance in the previous year's progeny-row trials and of which sufficient seed was available, were tested in small-scale replicated trials at three Departmental Farms in the Punjab, at the I.A.R.I., New Delhi and in PEPSU. Amongst these S. C. 51-220 gave from 0·2 to 26·5 per cent higher yield than the standards at all the five places. S. C. 51-43 outyielded the standards at three places by margins ranging from 17·46 to 36·65 per cent, and S. C. 51-49 excelled the standards at three places by margins ranging from 17·46 to 36·65 per cent. S. C. 51-51 which was tested only at Jullundur recorded maximum increase of 41·2 per cent in yield over the standard. S. C. 51-43 (Punjab 68-66 × Punjab 72-103) and S. C. 51-51 (Kashmir 2-596 × Punjab 72-103) have been tested at Jullundur for the last three consecutive years and have consistently outyielded the local by an average margin of 6·46 and 9·07 maunds of grain per acre respectively.

Rigorous selection of the inbred lines, obtained from the selfed material of the previous year, was made at both the stations, *viz.*, Rauni and Saproon of PEPSU. To study the effect of successive selfing on homozygosity, detailed observations of all the inbred lines were recorded. The characters studied were tasseling period, height of the plant, length and circumference of the cob, 100-kernel weight and grain yield per plant. The extent of homozygosity was judged by working out the co-efficient of variability. It was generally seen that characters like tasseling period, length of the cob and circumference of the cob reached homozygosity earlier than the height of the plant, 100-kernel weight and yield per cob. Out of 48 top-crosses tried in a balanced lattice design against one local, 12 top-crosses yielded significantly better than the local. The yield of the best top-cross, namely T. C. 55-27, was calculated to be 39·39 md. per acre as against 21·4 of the local, thus giving 82·9 per cent increased yield over the local. The same crosses when tried at Saproon did not give encouraging results. Out of 47 single crosses tried in a balanced lattice design against two locals nine gave significantly better yield than the best local. The yield of the best single cross namely S. C. 55-19 was 41·16 maunds per acre as against 25·65 maunds of the best local, thus giving 60·5 per cent increase over the best local.

Out of 8 hybrids supplied by the I.A.R.I., New Delhi, 2 hybrids namely K. T. 41 and U. S. 13 gave significantly better yields than the local.

Of the 28 single crosses tested against six controls in Rajasthan, the crosses 2731×2729, G9 (B)—2wh×p4-5y-1wh (4628·25 lb. per acre) and 2673×2681 Mid.R-2 (B)-1y×p4'-I(B)-1 (4628·25 lb. per acre) gave the highest yield. The hybrid N. C. 27 which was used as one of the controls yielded 2831·40 lb. per acre. Udaipur Selected, the local control, gave a yield of 2081·87 lb. per acre and $P(Y)_2$ gave the lowest yield of 2178·00 lb. acre. In a second trial, 25 top-crosses were tested against five controls, including the two best locals. The varietal differences were significant at 5 per cent level. The crosses N. C. 27 (61)-1 (4231·37 lb. per acre) and Tinpokhia-4 (3723·23 lb. per acre have shown significant performance over all other crosses and controls. The hybrid N.C. 27 used as one of the controls yielded 2880·42 lb. per acre, Udaipur selected, a local control, gave a yield of 2751 lb. per acre. Of the 40 top-crosses tested against six controls including the two best locals, the cross 4·51 R(51)-1-3 (3782·625 lb. per acre) followed by cross 405 LF(51)-2-2 (3209·50 lb. per acre) have outyielded the rest of the crosses and controls. The hybrid N.C. 27 used as one of the controls yielded 1819·375 lb. per acre. Udaipur Selected as control gave a yield of 1,604 lb. per acre.

Under the scheme of improvement of maize in Darjeeling (West Bengal) collection of types, inbreeding, making top-crosses and varietal yield trials were continued.

Hybrid maize

Nine of the U.S. hybrids were sent by I.A.R.I., New Delhi to Kanpur to be tested against K.T. 41, Pusa Yellow-2 and other U.P. types in large-scale plots at Kalianpur, Bahraich and Almora. Only six of them were tested under hill conditions at Hawalbagh (Almora, altitude 4,000 ft.). At Kalianpur, none of the hybrids yielded significantly higher than Meerut Yellow, Kalianpur Local and K. T. 41 Texas 26, a dent-seeded late-maturing double hybrid gave the maximum yield of 1,805 lb. per acre, followed by Meerut Yellow, an early improved type of U.P. with an acre yield of 1,608 lb. The yield differences were statistically significant. At Hawalbagh, Almora, the yield differences were statistically significant and Dixie 18, a late-maturing dent hybrid yielded significantly higher than all others. Compared to K.T. 41, only two of the late hybrids, Dixie 18 and N.C. 27 yielded significantly higher, while the rest were at the same level. K.T. 41 was the earliest in maturity of them all.

In the Gokak Canal Area of Bombay State, from an area of one acre, 8½ B. md. of single cross seed of I—5XL—5 and 4¼ B. md. of seed of pollen parent L-5 were secured. The third parent S-23 was sown and 3¼ B. md. of pure seed obtained. Two hundred and fifteen maunds of F_1 three-way hybrid seed was secured from the produce of 22½ acres. Besides, 51 B. Md. of seed of S-23 pollen parent from an area of 7½ acres was obtained. Therefore, 215 B. md. of F_1 three-way hybrid maize seed were available for distribution to cultivators and were sufficient to cover an area of about 1,500 acres.

The year under report was marked in Hyderabad by unusually wet *Kharif* season which adversely affected the crop growth. As a result of this a 14-acre block of Texas 26 parents was ruined. The *rabi* season was favourable and so a record yield of 6,000 lb. of grain and 10,000 lb. of straw was obtained from a plot where Texas 26 was

synthesised. One thousand two hundred pounds of seed so produced was distributed to farmers in the National Extention Service Block of Karimnagar, the centre of maize cultivation in Hyderabad.

In Rajasthan, trials with U.S. hybrids consisted of nine U.S. hybrids and five controls including two best locals. The varietal differences were significant at 5 per cent level. The hybrids Dixie 18 (3967·07 lb. per acre) and U.S. 13 (3889·29 lb. per acre) showed a significant performance over the hybrid Indian 252A, Wisconsin 641AA, Funk's hybrid and Dixie 11 and all the controls namely K.T. 41, me (y), Pusa yellow, Udaipur selected and Malan. Dixie 18 and U.S. 13 gave 50 per cent and 47 per cent higher yield respectively over Udaipur selection and local control. Four Punjab hybrids were also tested against a local control, namely Udaipur Selected; the varietal differences were significant at 5 per cent level. The hybrids PHI (3970·31 lb. per acre) and PH2 (3902·25 lb. per acre) have shown significant performance over Udaipur Selected and the local control (2835·94 lb. per acre). The hybrids PH1 and PH2 have given 40 per cent and 37·4 per cent higher yield over Udaipur Selected respectively.

Pulses

A trial of promising strains tested previously was designed at Berhampore Farm. T. 32 yielded highest with an average of 17·61 mds. per acre.

Multiplication of T-87

About 0·25 acre was put under multiplication with this variety for distribution of seeds to the farmers. The variety grows well under West Bengal conditions. Yield obtained was 15 md. per acre.

Scheme for the control of gram caterpillar in M. I

Insecticidal trials were conducted against *Heliothis armigera* Faler at Government Farm at Tharsa (Nagpur) and Powerkheda (Hoshangabad). BHC 5 per cent, Chlorodane 5 per cent and Toxaphene (50 per cent wettable) were applied in the form of sprays at 0·16 per cent concentration. It was observed that only DDT 5 per cent (dust) and DDT 0·16 per cent concentration (spray) were significantly effective after 24 hours of application. After 48 hours of the application, individually all the treatments were significant over control. These may be arranged in the following order of merit—DDT 5 per cent, DDT 0·16 per cent, Chlorodane 5 per cent, Toxaphane 5 per cent, BHC 5 per cent and BHC 0·16 per cent concentrations.

Arhar (*Cajanus cajan*)

Trial of promising strains

A yield trial with promising strains of *arhar* against a local was conducted at Berhampore, Chinsurah and Midnapore for the fifth successive year while the same experiment was conducted at Malda Farm for the third year. At Berhampore, Malda and Midnapore Farms, type 7 gave the highest yield, while at Chinsurah Farm, type 10 gave the highest yield.

Trial of wilt-resistant Cajanus *types*

The trial on eight wilt-resistant strains of *Cajanus* received from the Indian Agricultural Research Institute, New Delhi, was repeated this year in West Bengal for the fifth successive year at the State Agricultural Farm, Berhampore against type 62 as control. Wilting was not found in any of the plots and hence the type was taken to be resistant. Wield differences among the varieties were highly significant.

Time of sowing experiment

The replicated time of sowing experiment was conducted on *Cajanus* for the fifth year at Berhampore. There were altogether four sowings (treatments) commencing from 10th May (with the first shower available) every fortnight, the last sowing completing on the 26th June, 1956. It was observed that the first sowing *i.e.,* the sowing done on 10th May, gave significantly higher yield.

Effect of different spacings on Cajanus

The spacing trial on *arhar* against broadcast as control was conducted at Berhampore for the fourth successive year, to find out whether line sowing was better than broadcast, and if so, which spacing would give the maximum yield. From the results it was indicated that a spacing of 2 feet × 2 feet is the best for yield of *Cajanus*. The plots having 4 feet×4 feet spacing gave (significantly) the lowest yield.

Establishment of pure lines

Forty-six cultures that were carried over from the previous year were maintained as pure lines in small plots and single plant selections were made. These single plants were bagged and selfed to get pure seeds.

Lentil (*Lens esculentus*)

Twenty promising strains tested last year were tried at Berhampore Farm. Strain No. 57 came out as the highest yielder with an average yield of 31·47 md. per acre, while type No. 77 came out as the next highest yielder with 30·75 md. per acre.

Another preliminary trial on lentil was taken up at Berhampore with 10 promising strains tested last year; the difference in yield of the different strains was highly significant. Type No. T. 2 and T. 1 came out as the highest yielders with an average yield of 29·59 and 21·84 md. per acre respectively.

Trial of newly evolved strains

A yield trial with six selected strains of lentil was conducted at Berhampore State Agricultural Farm against Departmental Lentil No. 5 as standard for the fourth successive year. It was found that the yield differences amongst the types were not significant. Type No. NNPI (Hybrid) and CT 31 came out as the highest yielders with an average yield of 20·94 md. and 20·65 md. per acre respectively. The departmental variety gave exceptionally low yield.

Urid (*Phaseolus mungo*)

Maintenance of strains

Sixteen strains obtained as carry-over from previous year were maintained on small plots during the year under report.

Moong (*Phaseolus aureus*)

Phaseolus *species*

Three exotic *Phaseolus* types, *viz.*, *P. aureus, P. riciardianus* and P. *calcaratus* were tried at different State Farms as fodder and the farm bullocks were found to relish these crops. The strains were sent to the Fodder Botanist, Haringhata for detailed work on them. Of these three types, *P. aureus* was best for human consumption as pulse, but the quality was far below the standard of common *moongs*. Also, the long duration of the crop on the field is a positive handicap to its large scale cultivation. *P. riciardianus* and *P. calcaratus* have, however prospects as fodder crops.

Effect of early moong type No. 1 as green manure crop

Early moong type No. 1 was tried during the year under report as a green manuring crop for *aus* paddy. The result could not be taken due to late rains and late sowing of *aus* paddy. The same experiment will be repeated next year also to get conclusive results.

Collections and observation of moong *materials*

This year three collections were made from the fields of the *moong* growing tract of West Bengal (mainly Malda district). The samples were studied on small plots and economic characters were noted.

Pulse improvement scheme, Khargone, Madhya Bharat

Fifteen varieties of *moong* (*Phaseolus aureus*) from Bihar, I.A.R.I., (New Delhi), Rajasthan, Uttar Pradesh, Bombay and Madras were tried along with the local Nimari as control. The exotic varieties gave poor yield as compared to the local control. Nine varieties of *Urid* (*Phaseolus mungo*) from Bombay, I.A.R.I., Punjab, Uttar Pradesh and Madhya Bharat were tried along with local *Nimari urid* as control. Sindhbheda 1-1 from Bombay and Gwalior-2 from Madhya Bharat gave the highest yields but the differences in yield were not significant. The same tests were conducted in the case of *tur* (*Cajanus cajan*) and gram (*Cicer arietenum*) but the differences in yield were not significant.

Kheshari (*Lathyrus sativa*)

Twenty-five strains of Kheshari obtained as carry-over from last year were maintained on small plots during the year under report.

Pasture-land and Fodder Grasses

Grassland Reconnaissance Scheme

As proposed in the technical programme of the Grassland Reconnaissance Survey Scheme, a survey was undertaken in Saurashtra, Delhi, Andhra, West Bengal and Bihar. Owing to heavy rains in

Madhya Pradesh during October, (the time fixed for survey in that area) the survey could not be undertaken that year. So also, the survey had to be postponed for the next year in Orissa due to the absence of suggestions regarding the sites from that State. Eastern Uttar Pradesh could not be included due to the limitation of time. During the year a total of 88 sites were examined.

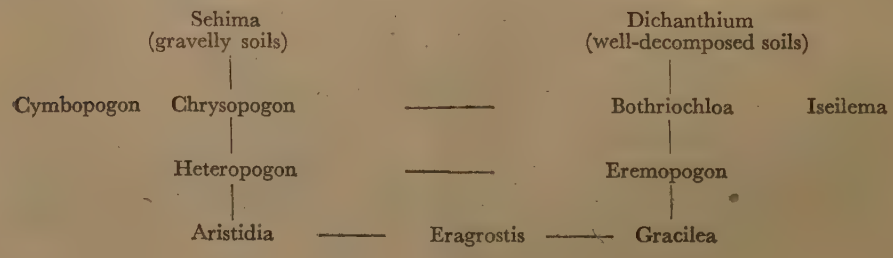
These sites are classified into types, according to the botanical composition, characteristics of the species, soil conditions, topography and general ecological principles. On examination of the data, all the sites fall under one of the three types, namely type I (*Dichanthium—Cenchrus*), type II (*Pharangmites — Saccharum*) previously described fully in 1954-55 report and type III (*Sehima — Dichanthium*). The majority of the sites, however, fall within type III (*Sehima —Dichanthium*) which was partly described in the 1954-55 report. The full description of this type has been obtained during this year. This type III (*Sehima — Dichanthium*) is represented extensively in Saurashtra and Andhra, in the ridges in Delhi State, in the hilly parts of Bihar, and in the western part of West Bengal. The common environmental factors associated with these sites are undulating to hilly topography with intervening valley portions and a rainfall range of 20 to 55 inches. The optimum development of this is in the rainfall range of 20 to 35 inches.

The various soils associated with this type are red, yellow red gravelly mixed with red and black, medium black soil of trap and gneissic origin, red loam, and laterite soils.

About 120 grasses were recognised in this type and 45 of them were perennials. Some of the most prominent among these perennials were *Sehima nervosum, Dichanthium annulatum, Iseilema laxum, Chrysopogon montanus, Bothriochloa pertusa, Eremopogon foveolatus, Heteropogon contortus and Cymbopogon* spp. Some of the prominent annuals found in this type were *Heteropogon contortus, Aristida* spp., *Gracilea royleana, Oropetium thomaeum, Eragrostis* spp., *Chloris tenella, Alloteropsis cimicina* and *Andropogon pumilus.*

This type showed the presence of a number of valuable legumes and the chief among them were *Heylandia latabrosa, Desmodium diffusum, D. triflorum, Alysicarpus rugosus, A. longifolius, Indigofera cordifolia, I. glandulosa, Rhyncosia capitata, R. minima* and *Crotalaria medicagenea.*

The regressional trends seen in this type are represented by the following diagram.



In the management of this type, *Sehima nervosum* and *Dichanthium annulatum* are to be considered as the key species. Since *Sehima* occurs on hilly areas, any bad management of the well-developed *Sehima* stand will tend to result in accelerated erosion. So, the best management practice will be to maintain a dominant stand of *Sehima* on gravelly soils and *Dichanthium* on level soils. To maintain a good stand of *Sehima* it is necessary to take soil conservation measures on hilly situations. The best utilization of grasslands dominated by *Dichanthium* alone or mixed with *Iseilema* spp. is to use them for hay purposes. If used for grazing purposes, it is preferable to have post-monsoon grazing.

Scheme for improvement of pasture grasses and legumes, Bombay

Seed samples of 48 species of grasses and 46 legumes were received and tested. A number of individual plant selections were made among the perennials and annual grasses and legume species material was thus collected for breeding work. Manurial and varietal trials of grasses like Thin Napier, Rhodes and Marvel were also done. The manure used was four levels of nitrogen (0, 20, 40 and 60 lb. per acre). Results are awaited. An experiment was conducted to determine the effect of growing grass and legume in mixture. Observations were also made on the effect of varying the number of cuttings on the yield of different grasses.

Scheme for fodder production, Coorg

Six varieties of *jowar* were grown and it was found that varieties Co. 1 and As. 7657 in the monsoon season gave good results. *Jowar* As. 7657 was a long-duration variety and a heavy yielder. Oats have the highest yield of 15,200 lb. if sown during the monsoon period. Among the fodder legumes *Dolichos lablab* was grown for seeds only. Senji, Barseem, soyabeans, *Centrosema* and *Glycine* gave good results during the monsoon period.

Fodder production in Bhopal

During this year, 59 fodder species in *kharif* were tested in small plots and their agronomic characters were recorded. Twelve legumes and 10 non-legumes were found promising for further trials. Yield trials of three legumes and four non-legumes were conducted under irrigated conditions.

Out of the three legumes tried, *Melilotus alba* gave the highest yield of 6,666 lb. per acre. No significant difference in the yielding capacity of *Melilotus alba* over *Medicago sativa* (yielded 5,666 lb. per acre) was observed. Both of these were significantly superior to *Trifolium alexandrinum* (yielded 2,226 lb. per acre). Out of the five non-legumes tried, oats Alegenti gave the highest yield of 11,573 lb. per acre and was superior to the rest. *Phalaris minor* and Oats (I.C.A.R.) were at par with each other. *Panicum antidotale* was significantly superior to *Chloris gayana.*

Manurial trials with varying doses of N and P fertilizers singly and in various combinations with K fertilizer on three non-legumes under irrigated conditions were conducted.

Oats Brunkar 10 was found superior to *Phalaris minor* and *Panicum antidotale*. A combination of 30 lb. N. plus 30 lb. P_2O_5 plus 40 lb. K_2O per acre was found significantly superior to the rest of the manurial treatments. Response to higher doses of N. was significant. Response between 30 lb. N per acre and 20 lb. N per acre was not found significant.

Manurial trials with varying doses of N and P fertilizers singly and in combination with K fertilizers on three legumes under irrigated conditions were also undertaken. *Melilotus alba* was found superior to *Medicago sativa* and *Trifolum alexandrinum*. A combination of 30 lb. N plus 30 lb. P_2O_5 plus 40 lb. K_2O was found decidedly superior to the rest of the manurial treatments. Response to P fertilizers was considerably high.

Manurial trials to find out the response of K fertilizer (20 lb.) on two legumes and three non-legumes under irrigated conditions were carried out. K had highly significant response, but higher doses of K were found unnecessary. Among the legumes, *Melilotus alba* was found superior to the other legumes. As regards non-legumes Oats Brunkar 10 was the best.

At the I.A.R.I., most of the exotic materials were obtained through the courtesy of the Plant Introduction Section of the Division of Botany and indigenous material through the I.C.A.R., Grassland Survey Scheme. The seed samples of 167 grasses and legumes were obtained during the year. Regular agronomical observations were recorded on the material established. The following grasses and legumes showed promise :

A. *Irrigated*

(1) Grasses: *Chloris gayana* (A·2803) ; *Eriochola nubica* (A·2404); *Panicum coloratum* (A. 2735); *Pennisetum ciliaris* (A. 2814, 2820) and *Pennisteum masaicum* (A.2823).

(2) Legumes : *Alysicarpus vaginalis* (A.2738) ; *Controsema pubescens* (2792) ; *Leucaena glauca* (A.2795) ; *Medicago sativa* (Sirsa 9 *and Hunter river*) *and Melilotus alba* (A. 2865).

B. *Rainfed*

Seventy-three grasses and six legumes were successfully established under an average rainfall of 28·75 inches. The following herbage species showed promise (these materials were selected on the basis of green fodder produced, recovery after cutting and ability to withstand conditions of drought):

Brachiaria brizantha (2105); *Cenchrus ciliaris* (Bold Aust.); *Chloris gayana* (*A.* 2495); *Eragrostis curvula* (*A.* 2519); *Cynodon dactylon* (A.2752); *Panicum coloratum* (A. 2534); *Panicum antidotale* (*Karnal*) ; *Panicum maximum* (thin guinea A. 2341) ; *Panicum repens*, *Pennisetum pedicellatum ; Urochloa sp.* (A. 2088) ; *Urochloa mosamicensis* (A. 2081); *Dolichos lablab; Desmodium purpureum; Phaseolus lathyroides* (2308); *Pueraria hirsuta* (*Kudzu*) and *Mucuna cochinchinensis.*

Yield trials

Irrigated : The 15 promising grasses included in the trial were regularly cut for green fodder during the third year after planting. They received four irrigations and fertilizer at the rate of 60 lb. nitrogen per acre applied in two equal doses, one-half in spring and the rest with the onset of monsoon. The highest yield of 1,350 md. per acre was obtained from *Brachiaria mutica* followed by *Setaria sphacelata* which yielded 975 md. per acre. Grasses which recorded yields of over 400 md. were: *Brachiaria brizantha* (2,105) ; *Chloris gayana* (2,495); *Urochloa mosambicensis* (A. 2081) and *Pennisetum pedicellatum.*

Rainfed: Six of the promising grasses were included in this trial on the basis of observations of the previous years. In the first year *Chloris gayana* (giant Rhodes) gave the highest yield of 289 md. per acre, closely followed by *Urochloa mosambicensis.* The yields in the case of *Panicums* were just half of Rhodes grasses; *P. coloratum* gave the highest yield ; there was no marked difference in the yields of *P. antidotale* and *P. maximum* (thin stem).

Rabi grasses (irrigated)

The four winter grasses included in the trial are given below in the order of the yields obtained:

Avena glauca; Avena sativa; Secale cereals and *Phalaris minor.*

Co-ordinated testing

The seed samples of 20 grasses and 9 legumes were sent to 13 centres having different soil and climatic conditions, for adaptability tests. The performance report indicated that the following material showed promise at most of the centres:

Chloris gayana (A. 2495); *Cenchrus ciliaris* (Bold); *Setaria sphacelata* (A. 2174) ; *Urochloa* sp. (A. 2085) ; *U. mosambicensis* (A. 2088) ; *Desmodium purpureum; Mucuna cochinchinensis* and *Phaseolus lathyroides.*

Chemical analysis

Eight grasses and four legumes were analysed for their nutritive value. *Digitaria eriantha* and *Urochloa pullulans* were observed to contain the highest percentage of crude protein amongst grasses. They were also fairly rich in calcium and phosphate content. *Phaseolus lathyroides* contained the highest percentage of crude protein and calcium among the legumes analysed.

Multiplication and distribution of seeds and planting material of promising grasses

Multiplication: The promising materials were multiplied. Planting materials and seeds were supplied to 10 centres for further multiplication and field trials at the I.A.R.I., New Delhi. The selection of grasses and legumes was done on the basis of adaptability tests conducted during the previous two years.

Distribution : A number of seed samples and planting material of grasses and legumes were supplied to both States and private

agencies all over the country. Apart from this, bulk quantity of seeds and planting material of grasses like Blue Panic, Rhodes, Anjan, Setaria, Guinea, Napier, Sudan grass and seeds of legumes like Mucuna, Lucerne, Burclover, Huban clover and *Dolichos* were also supplied to the various agencies in the country.

Agronomy

Green manuring

Wide variations were found between different green manuring crops regarding their suitability to different environmental conditions during investigations under the scheme for improvement of green manuring crops for rice areas at the Central Rice Research Institute, Cuttack. Besides the commonly grown crops (*i.e.*, Dhaincha and Sunnhemp) *Aeschynomena americana* and *Phaseolus semierectus* were found to be promising for sowing during the main crops season. *Moong* type No. 1 and cowpeas (*Vigna sinensis*), also because of their quick growth, were promising for green manuring purposes. *Crotolaria useramoensis, C. brownei* and *Sesbania sirecea* were suitable for growing in vacant places for the second season rice crop *i.e.*, December to January). *Moong* which was commonly grown for grain purposes was also capable of giving a large quantity of succulent and easily decomposible green matter. Some crops (*viz.*, wild indigo. *Sesbania speciosa, Cassia leschenaultiana, Phaseolus semierectus* and *Tephrosia candida*) were found to be suitable for sowing in the standing crop of rice. Apart from them, perennial shrubs like *Gliricidia maculata* showed promise for planting on the sides of roads and channels, as it gave an average yield of about 25 lb. of leafy matter per plant. *Tephrosia purpuria* and *T. notiflora* were found, to be completely drought resistant. Similarly, besides *dhaincha, Sesbania sirecia, S. speciosa, Aeschynomena americana* and *Phaseolus semierectus* were outstandingly resistant to water-logging prevalent in low-lying rice areas. As in the previous years *Aeschynomena americana, Tephrosia candida* and *Crotalaria sp.* (like *C. usaramoensis, C. brownei* and *C. striata*) were found to be heavy seed-yielders (yielding 880 lb. 680 lb., 675 lb., 968 lb., and 690 lb. per acre respectively). The two *Crotolarias* (*C. usaramoensis* and *C. brownei*) were found to have higher nitrogen content, nearly double that of *dhaincha* and sunnhemp *i.e.*, 4·8 and 4·6 per cent nitrogen on dry weight basis in *C. usaramoensis* and *C. brownei* respectively, while the comparative data was only 2:9 and 1·9 per cent nitrogen for *dhaincha and* sunnhemp respectively.

Time of burying : The time of burying of *dhaincha* was found to be related to the age of the green-manure crop. Eight-week old plant was succulent and could be ploughed under during planting, while 12-week old *dhaincha* was to be buried under 8 weeks in advance of planting. The maximum yield of 2,877 lb. paddy per acre was obtained when 8-week old *dhaincha* was incorporated just before planting the paddy crop.

Mixed cropping

Mixed cropping for green manuring

As in the previous year, incorporation of *dhaincha* in rice by burying it 6 to 8 weeks later, at the time of beushenning gave substantial

increase in the yield of rice. Application of ammonium sulphate (at 10 lb. per acre) as a top-dressing after burying in *dhaincha* at beushenning gave the best yield of 2,200 lb. per acre. It could not be recommended, therefore, that *dhaincha* could be sown mixed with broadcast rice and buried at beushenning and be top dressed (with 10 lb. nitrogen per acre) for increasing rice production.

Comparison of growing in situ

In the comparison of the efficacy of *dhaincha* and *sunnhemp* grown *in situ* and green matter brought from outside for incorporation in the soil (in conjunction with phosphate, ammonium sulphate and lime) both *dhaincha* and *sunnhemp* gave identical yield response on rice crop. But, unlike last year, green matter brought in from outside and incorporated in soils was comparatively better than the green manuring crop grown *in situ*. Application of an additional quality of 30 lb. N. as ammonium sulphate over the basal dressing of green matter depressed the yield significantly. On the other hand, the application of 50 lb. P_2O_5 in conjunction with the green manure gave increased yield by about 117 lb. paddy per acre on an average. In another set of experiments conducted to compare the efficiency of burying (at 10 weeks' age) various green manure crops grown *in situ* and brought from outside (equal quantities of different green manures at the rate of 5,000 lb. per acre were applied at the time of puddling of the rice field) on the yield of the subsequent rice crop, it was found that *Cassia leschenaultiana* and *Crotalaria striata* were superior to the other green manure crops in increasing the yield of the succeeding rice crop. They, however, gave identical response when grown *in situ* or brought from outside *viz.* 7·3 to 10·6 per cent over the control when they were grown *in situ* while the yield response ranged from 17·8 to 19·9 per cent when they were brought from outside and buried in the soil at the time of planting of rice.

Rotation

Trials with *moong* crop grown after the harvest of the main season rice both for green manuring or for seed with and without P_2O_5 showed that it was advantageous to grow *moong* for green manure and bury it at flowering. This gave the maximum yield of 2,578 lb. of paddy per acre. On the other hand, *moong* crop grown for seed purposes did not benefit the succeeding rice crop and the application of P_2O_5 either to *moong* or to rice crop did not give any increase in yields.

Green Manuring Scheme, Bihar: The object was to evolve suitable agro-techniques to fit in the different species of green manuring crops in the cropping system followed in the different tracts of Bihar for increased crop production particularly in paddy and wheat. Trials on the effects of *sunnhemp* buried *in situ, sunnhemp* plants applied cut and stubbles of sunnhemp, against no manure, on paddy and wheat yield did not show any appreciable difference from each other. Green manuring with *Cassia tora, C. occidentalis* and *Sesbannia aculeata* did not show any appreciable difference among themselves in relation to paddy yield. There was no appreciable difference in paddy yield due to the application of 50 maunds per acre of different green manuring

plants (*Calatropis, Sesbania speciosa, S. punctata, S. aculeata, Crotalaria juncea, Glyricidia maculata, Indigofera tinctoria* and *Tephrosia purpurea*). Yields of paddy due to the effect of *Sesbania aculeata* sown at different seed rates (of 8, 12, and 16 seers per acre) differed appreciably from each other; the last giving the highest yield.

Mixed cropping

In sowing *Asihynomena americana and Indigofera bardada* broadcast along with paddy seeds to be incorporated in the soils, *bardada* followed by *Sesbania* was found to be promising.

Indigofera bardada followed by *Sesbania aculeata* was the most effective for green manuring wheat crop. *Sesbania aculeata* (applied at 300 maunds per acre) gave the highest yield of wheat compared to *Calatropis procera, Sesbania speciosa* and inorganic manures (of 150 lb. nitrogen per acre of ammonium sulphate or 40 lb. of superphosphate with 80 lb. of ammonium sulphate per acre).

In the 'Co-ordinated scheme for the improvement of green manuring the practices' in Jogindernagar, Himachal Pradesh, to find out suitable species for green manuring during *kharif* and *rabi* for the benefit of paddy crop mainly, and to find out the comparative beneficial effect of phosphatic manures on the cultivation of these species, trials with 13 species of plants to find out which of them was best suited for cultivation between the post-*rabi* and pre-*kharif* cultivation period when the *rabi* wheat was followed by a *kharif* transplanted paddy, showed that sunnhemp gave the best results, followed by *moong*. The yield of sun-flower, blackgram and horsegram were also encouraging. The plots which have higher yields of green manure also gave higher yield of paddy. In the manurial trial with seven species of green manure plants to find out the comparative beneficial effect of superphosphate (applied at the rate of 20 lb. P_2O_5 per acre) on the yield of green manure and nitrogen fixation by different species, it was found that sunnhemp gave the best yield of paddy, followed by *moong* (green gram) and sunnhemp. The yield of paddy was in proportion to the yield of green matter buried in the plot and the application of P had no effect on paddy yield.

In an experiment with seven leguminous species sown after monsoon in the standing crop of paddy/after the harvest of paddy with application of 20 lb. P_2O_5 per acre, berseem, senji, shaftal and metha gave poor germination when sown in the standing crop, but *matri* (*Lathyrus aphaca*) did well. In the manurial trials, sunnhemp gave the best results, giving the highest yield of green matter followed by *moong*, gulthi (horsegram) blackgram and moth in descending order.

In the green manuring scheme (Rajendranagar) Hyderabad, the objective was to find out suitable types of green manuring crop and shrubs under different soil and climatic conditions of the State to fit in the important cropping schemes, both under rainfed and irrigated cultivations. Study of the growth of green manuring crops, their optimum sowing time and possibilities of rotation with paddy (in black and chalka soils) and with wheat and *kharif* cotton (in clayey and sandy loam soils) were also taken up.

Weed Control

In the Weed Control Scheme, Madras, the following results were obtained during the current year:

(i) *Cynodon dactylon*—Sodium 2, 4-D and sodium MCPA at 10 lb. per acre and ester of 2, 4-D at 20 lb. per acre plus diesel oil at 5 gallons per acre gave complete scorching of the aerial portion of the weeds within 15 days of the treatment, though their basal portion remained green. But greater percentage of kill was recorded in the case of the treatment on these two weeds soon after digging up of the fields, as the fresh growth of weed was unable to withstand the toxicity of the weedicides.

(ii) *Cyperus rotundus*—A single treatment of 2, 4-D Butyl ester and MCPA (at 5 lb./acre each) given to plots previously treated with a mixture of 2, 4-D Butyl ester plus MCPA (at 5 lb. per acre) applied in two doses in diesel oil at 5 gallons per acre gave comparatively higher percentage of mortality.

(iii) *Spergula arvensis*—Extar Sandoz at 8 lb. per acre and Triherbide mixture at 20 lb. per acre were effective against *Supergula arvensis* at Nanjanad.

(iv) *Oxalis latifolia*—Butyl ester (at 5 lb. per acre) and Triherbide mixture (at the rate of 20 lb. per acre) gave over 90 per cent kill of *Oxalis latifolia* at Nanjanad. Of the two, the former was more promising.

(v) *Lantana camara*—Spraying 2, 4, 5-T ester (at the rate of 20 lb. per acre) severely scorched *Lantana camara* at Ambalavayal in Kerala. Pruned bushes were affected more than the unpruned, and bushes pruned to a height of 2 ft. above ground level were killed earlier and more easily than others. There was no great difference in spraying in early morning and late in the evening. There was no residual yield-reducing effect by any of the weedicidal treatments on *bajra,* horsegram or paddy when they were grown in fields subsequent to treatments.

In the scheme of 'research on the eradication of weeds by the application of hormone types of selected weedicides' at the Bose Institute, Bengal, the most effective stage for action for optimum effects of the weedicide was the early stage of growth; while in the case of Crag herbicide, harmful effect on the crops was noticed in the preflowering and harvesting stages. Better effects were brought about by the sprays than by the dusts. In spraying, emulsions showed better sticking quality than mere solutions and the use of carriers improved the effect of the sprays. The penetrating power of emulsions and solutions was more than dusting with powders. As to the residual effect of the herbicides in the soil (as indicated by the growth studies on *Meliolotus alba* grain after the treatment) each herbicide had its own degree of residual toxic effect. Drift effect on the jute crop growing in the neighbourhood showed that the herbicidal effect extended up to $1\frac{1}{2}$ ft. from the location of treatment.

In the Weed Control Scheme at the Central Agricultural Research Farm, Nabi Bagh, Bhopal, trials with Ester of 2, 4-D (Kathon E 40, 55·6 per cent acid equivalent) and Amine salt of 2, 4-D (40 per cent

acid equivalent) 0·2 gallon, 0·13 gallon and 0·1 gallon sodium salt of 2, 4-D (Fernoxone-80 per cent sodium salt of 2, 4-D) 1·2 lb. 0·8 gallon and 0·4 lb., and 2, 4, 5-T (20 per cent Amine salt) 0·3 gallon, 0·2 gallon and 0·1 gallon, MCPA (Phenoxylom 30 acid equivalent) 0·22 gallon, 0·15 gallon and 0·1 gallon on weeds in *kharif jowar* fields when the weeds were in flowering and fruiting stages showed that the following weeds, *i.e., Indigofera glandulosa, Psoralea corylifolia, Abution indicum, Corchorus olitorius, Corchorus trilocularis, Digera arvensis, Achyranthus aspera, Corchorus fasicularia, Vicon auriculata. Euphorbia hirta, Sida spinosa, Balsum* (wild) were killed within a fortnight and in the case of 2, 4-D, even within a week.

Cassia tora—Ester of 2, 4-D (0·8 gallon and 0·55 gallon) killed *Cassia tora* within a week.

Kans—CU 80 per cent 3 (P-ch) orthophenyl—1, 1-dimethyl urea at the rate of 12 lb., 8 lb., and 4 lb., in 100 gallons per acre killed the foliage of kans within 25 to 30 days. There was no regrowth till June in the plots treated with 12 lb., while there was regrowth in the case of the other two doses. However, new shoots appeared after two months from treatment.

In the wheat field, amine salt of 2, 4-D ester of 2, 4, 5-T and MCPA killed seedlings of *Convolvulus arvensis, Launea pinnatifida* and *Meliolotus alba* within 7 to 11 days. The crop was not affected by the treatment, though in some cases, particularly when Tributon was tried there was slight scorching of leaves and stunting of growth. In the pre-flowering and flowering stages of *C. arvensis* and *Launea* the effect was almost the same as in the case of seedling stage. But the time taken for the death of the plants was slightly lesser than at seedling stage. Tributon and Ester of 2, 4-D were more effective for the weeds (in the seedling stage) of sugarcane field and the herbicides had no toxic effect on the sugarcane crop. In the co-ordinated weed control schemes, Madhya Bharat, sodium salt of 2, 4-D (0·50 per cent) was effective in killing *Xanthium strumarium* (Adhasisi) to the extent of 87·6 per cent in a period of 8 days. Sodium salt MCPA at 0·3 per cent gave 68·3 per cent mortality in a period of 12 days. Spraying with 3·0 per cent sodium salt of 2, 4-D Dichlorophenoxy acetic-acid gave quite encouraging results in the case of *Jharberi, Zizyphus rotundifolia*. Sodium salt of TCA (6·0 per cent) gave a mortality of 93·4 per cent of *Cynodon dactylon* in four weeks time. *Saccharum spontaneum* was affected only by 9·0 per cent sodium salt of TCA giving mortality to the tune of 87 per cent at Bhilsa, 2, 4-D Sodium salt was effective against Dicots and TCA against Monocots. Spraying was superior to dusting and seedling stage was the most vulnerable period for herbicidal effect.

As a result of survey in the "Weed Survey and Control Scheme" Himachal Pradesh, it was found that *Oxalis acetosella, Cyperus rotundus, Sorghum halepense, Ageratum* spp. *Lantana camara, Chenopodium album, Funaria passiflora, Vicia* spp. are the most common weeds occurring in the cultivator's fields in Himachal Pradesh. Out of the 45 different plant species recorded occurring as weeds in the crop fields the first three were the most important. Experiments were conducted with different weedicides (Sodium salt 2, 4-D ; Methyl 4 chlorophenoxyacetic acid, Sodium trichoracetate. Trichloroacetic

acid, Ethyl ester of 2, 4-D; Amine of 2, 4-D Pentachlorophenol; and 3, 4, 5-Trichlorophenoxyacetic acid) on *Oxalis acetosella* and *Cyperus rotundus.*

(a) *Oxalis*: *Oxalis* showed resistance to practically all these. Herbicides showed immediate kill of the vegetative parts of the plants after the application of the weedicides, but a fortnight later new shoots appeared from the underground bulb. The bulbs resisted the action of the weedicies, but ester and amine of 2, 4-D had an indirect effect on the bulbs, so that they reduced new bulb formation to a very great extent.

(b) *Cyperus rotundus*: *Cyperus rotundus* responded favourably to the amine and ester of 2, 4-D. Its shoots were killed within a week of the application, and did not reappear, for their underground rhizomes also were affected. The number and size (as measured by weight) of the rhizomes of the amine and ester treated plants were markedly reduced as compared to those of untreated ones.

In the Scheme for the Control and Eradication of Weeds (at the Agricultural College, Bapatla) Andhra, it was found that Fernoxone and Hedonal (M) were the best herbicides for controlling the weeds in *ragi* crop with minimum loss to the crop. Even though Tributon was also good for this purpose, it was toxic to the crop plant. In preplanting treatments (one month before planting *ragi*) there was injurious persistency of herbicides affecting the crop. The safest period for treating the crop was one month after planting. The optimum doses for Fernoxone were 10 and 5 lb. concentrations. On the whole *ragi* was highly resistant to the action of herbicides when compared to other crops.

Herbicidal effect on crop : Only preliminary experiments with low doses of herbicides were conducted, taking the stage of the weed as the criterion. The paddy crop was sprayed when the weed was at seedling and full vegetative growth stages. The weeds, mainly grasses, were not controlled (at 0·2 per cent doses). The dosages of herbicides were also not toxic to the paddy crop, as the grain yield was unaffected. The visible adverse effect was only the development of tabular leaves. Preplanting treatment with 2, 4-D or MCPA compounds and 2, 4-D at 6 weeks' interval to the soil did not control the weeds. But it injured the brinjal crop which was found to be highly susceptible at all stages of its growth. Similar was the case with chillies too. The germination of ground-nut was only 40 per cent in pre-sowing treatment plots with 2, 4-D or MCPA compounds. When spraying was done on standing crop there was very heavy mortality, and the pod formation was also very poor.

Cyperus rotundus : The aerial portions of *Cyperus rotundus* were killed when Fernoxone (at 2·0 per cent, 1·5 per cent, 1·0 per cent, and 0·5 per cent) was sprayed and further regrowth was inhibited for three months.

Cynodon dactylon : *Cynodon dactylon* was killed when 5 per cent (50 lb.) Fernoxone per acre was sprayed. Trimming the grass before spraying increased the effect of the spray.

Weeds like *Commelina bengalensis, Boerhavia diffusa, Argemone mexicana* were highly susceptible to the action of spray of any compound of 2, 4-D or M.C.P.A.

Croton sparsiflores was killed by spraying 1 per cent Fernoxone or Tributon at any stage of its growth. *Trianthema portulacastrum* was killed by one per cent Fernoxone or Tributon at seedling stage. It was killed at full vegetative growth only by Tributon at one per cent, whereas Fernoxone at the same concentration had no effect.

Phenology

In the phenological study at the Central Meteorological Observatory at Poona, the isochrones of the average date of flowering of mango showed that, considering the whole of India, the variation in the time of flowering of the mango, from the extreme South (about latitude 80 N) is approximately from 15th December to 15th March (about 90 days). Therefore, the phenomenon appears to be delayed by about 3·6 days for every degree of latitude northwards, which is quite near to four days, suggested by Hopkins for North America in his famous 'Bio-climatic Law'. However, there was considerable difference in this value from South to North India. The difference in the flowering date per degree of latitude was about two days in the extreme south and about 10 days in the extreme north-west of India, where there was also a rapid increase in altitude northwards. Nevertheless, insofar as the observation is based on 3 to 5 years' data only, the tentative inferences remain to be verified when data for a sufficiently long period are available.

Soil Science

Evaluation and standardization of technique

In the scheme for 'Standardization of Methods of Soil Analysis' at the field Research Station, Bombay, with the objective of examining the existing methods of soil analysis and selecting with necessary modifications the most suitable among them for the Indian conditions, four methods were evolved *i.e.*, (i) for finding exchangeable bases (calcium) in the soil; (ii) for finding carbonates in soils; (iii) for the measurement of *p*H value of soils; and (iv) for the mechanical analysis of soils—methods of soil dispersion preparatory to mechanical analysis.

In the scheme of research on examination of rapid methods of soil test for soil survey at the Indian Agricultural Research Institute, Delhi, with the objective of developing rapid soil tests for advising the farmers regarding the fertiliser requirements of the soils (from different States/regions of the country) available phosphorus (by Spurway, Trugo, Bingham and Morgan methods) potassium by citric acid 1 per cent, normal ammonium acetate, Morgan's extractant and 0·5 HNO_3 with $\frac{1}{2}$ and 1-hour heating respectively, and nitrogen (by alkaline permanganate, Iowa rapid nitrification and Richardson's modifications of Olson's method) were determined and correlated with crop yield data. In the case of available phosphorous and potassium correlation, co-efficients were very low for all the methods and none were significant. On the other hand, last year's results indicated significant correlation with Morgan's extractant in the laterite soils, and

almost all the methods gave significant correlation in Alwaye. The available N as estimated by the alkaline permanganate method gave significant correlations in a number of soils with wheat, paddy and *bajra.* The Iowa rapid nitrification method gave practically no correlation with paddy but gave significant correlation in the alluvial soils of Delhi for wheat and *bajra.* Richardson's modification of Olson's method gave significant correlation in none of the soils. This was in conformity with the previous year's results.

Micro-nutrients

In the scheme on the "Micro-nutrient status of the principal soils of the Bombay State" the primary object was to survey the micro-nutrient status of the principal soils of the Bombay State and to conduct field experiments on the Government farms to determine the response of food crops, to the more common micro-nutrients. Soil analysis indicated adequate supply of micro-nutrients in Banaskantha district of Gujrat. Soils of Mehsana district, however, appeared to be deficient in molybdenum and zinc and in some cases in manganese also. Field experiments conducted at Mohol Farm on jowar, showed response to boron. Wheat crop significantly responded to zinc application at Vijaypur Farm and gave 21·6 per cent increase in yield. Similarly, the combination of boron, molybdenum and zinc also gave significant increase in yield of gram amounting to nearly 42 per cent. Copper, however, had a depressing effect on the yield.

Microbiology

In the scheme on 'The survey of the microflora of soils in relation to their structure, and the role of earthworms, etc.," in the Fermentation Technology Laboratory, Indian Institute of Science, Bangalore, with the objective of studying the role of the earthworm in the alteration of the structure of soils, the enrichment culture methodology revealed that the genus *Pseudomonas* was the most frequently encountered and a versatile group capable of attacking practically every substrate employed for study. They were mainly responsible for the rapid decomposition of substrates like glutamate, oleate inositol or citrate, whatever the soil type may be, while in the case of pectin it appeared that the type of organism involved depended on the type of soil, the coarser sandy soils favouring only *Bacillus* as pectin decomposers. Urate decomposition in soils appeared to be better accomplished by *Bacillus* than *Pseudomonas.* An interesting observation was the demonstration of the quantitative utilisation of pectin by chemical methods in pure cultures of *Pseudomonas,* which was significant in view of the fact that only two micro-organisms (belonging to the *Bacillaceae* family) were so far reported to be able to quantitatively utilise pectin in pure cultures. The isolation of coryneform bacteria from glycine, glycerol, hippurate and asparagine was suggestive of the role of these organisms in the transformation of these substrates in soil, though hitherto it had appeared that these organisms had no particular role in soil.

Land reclamation

In the scheme for 'Land Reclamation', Andhra State (Bapatla) the objective was to carry out investigations on the different methods for the reclamation of saline and alkali lands and to suggest the

most suitable among them, for their reclamation in the coastal districts of Andhra State. The work so far carried out included preliminary survey of topographical features of the land and its drainage problem, seasonal variation in sub-soil water-table, soil survey and analysis of soil and waters at the Saline Research Station, Masulipatam.

Manurial trials

In the scheme for 'Research on the Application of Ammonium Sulphate to paddy lands of West Bengal' with the object of finding out if continuous application of ammonium sulphate to the same paddy lands year after year has any deleterious effect on crop yield and on soil conditions, bonemeal and farmyard manure were applied to the field at the time of general preparation of land and ammonium sulphate four weeks after transplantation or sowing. Lime was applied every fourth year of the experiment six weeks before transplantation. It was found that both the height and number of tillers of the plants increased by the application of ammonium sulphate. Though at Berhampore and Chinsura farms, these increased continuously with the increasing doses, at Suri farm no further increase was obtained beyond the dose of 60 lb. N per acre. Crops receiving ammonium sulphate at a rate higher than 30 lb. N per acre lodged in Chinsura and Suri farms. But at Berhampore farm lodging took place when the dosage was 60 lb. N per acre. The growth of the plants increased by the use of farmyard manure. The increase was only slight at Chinsura and Suri farms but quite considerable in Berhampore farm. Bonemeal, too, produced small effect on growth, particularly at Chinsura and Suri farms. Lime, however, did not show any such effect in any of the farms.

The objective of the "Scheme for Manurial, Varietal and Agronomic Trials to Determine the Optimum yields of Crop in West Bengal" was to find out the effect of ammonium sulphate alone and ammonium sulphate plus superphosphate on paddy and of ammonium sulphate and ammonium sulphate plus potash on the yield of jute by simple experiments on farmers' plots. The following conclusions were arrived at for the optimum yield of paddy: a mixture of N and P was necessary at Burdwan, but only N in Hooghly. In the districts of Hooghly, application of nitrogen to increase yield of paddy was always economical. There were, however, indications of phosphate being the limiting factor for optimum production in areas such as in Damodar alluvial area where application of phosphate over N was not economical. Economical yield of paddy was obtained in red soils and in Ganga Flat lands when a mixture of phosphate and nitrogen was used. But in Damodar Riverine soils economical yield of paddy with N and P application was obtained only with sandy loam and silty loam types of soils. In Damodar Flat lands, clay loam, however, gave economical yield of paddy with P over N. But from the economic point of view only nitrogen could be recommended for increasing the paddy production in both these areas. For jute a mixture of N and K should be used for optimum production both at Hooghly and Burdwan. The current prices of jute were sufficiently attractive to allow a mixture of K and N for economic production of jute at least in Hooghly. In jute also there were limitations to the use of potash, regarding soil association. In the Damodar Riverine

Association, the loams were the most responsive to application of K over N, followed by sandy loams, clay loams and sandy clay. In Ganga riverine tract the average indicated economical response of potash with clay and loam type of soils only. Nitrogen alone was, however, economical in all the soils. In the Damodar riverine soils, application of K to nitrogen in sandy loam, loam and clay loam gave good yields of fibre and profits. But with sandy clay loam and silty loam, on the contrary, profits were less. Species belonging to the *Aspergillus* and *Penicillium* genera appeared to be almost equally important entities responsible for the breakdown of inositol and oleate in soils. Sucrose was the only substrate which could consistently enrich micro-organisms of the *Enterobacteriaceae* family, (*viz., Aerobacter* and *Paracobactrum*). The role of earthworms in the alteration of soil microflora was also investigated on similar lines as for the survey of microflora. Microbiological analysis of the soil was made from time to time up to a period of six months. It was found that *Azotobacter* increased the number of the nitrogen-fixing organisms nearly four times more in soil inhabited by earthworms than in the same control soil devoid of earthworms.

Investigations were taken up in the scheme on 'Azotobacter inoculation of crops' at the State Agricultural Research Institute at Tollygunge, West Bengal, to find out the effect of seed inoculation with *Azotobacter* on the growth and yield of *aus* paddy and jute. The probable causes of scarcity of *Azotobacter* in the soils of West Bengal such as (i) water logging (ii) occurrence of toxic substances in soil and (iii) the deficiency of phosphate and trace elements were studied. Water-logging of soil caused a definite decrease in the number of *Azotobacter.* But there was no indication of any toxic substance. At the same time, it was found that the soils of West Bengal were highly deficient in phosphate and trace elements, for the active multiplication of *Azotobacter.* Pot experiment to study the effect of inoculation of *Aus* paddy gave promising results in the current year.

In the scheme on the 'Study of the effect of Legume Seeds Inoculation and Strain Competition' (Presidency College, Calcutta) West Bengal, to study the different factors affecting seed inoculation under different soil and climatic conditions prevailing in West Bengal and to find out the reasons for the frequent failure of crops after seed inoculation, over 40 different samples of root nodules of the pulses (*viz., Lens, Cicer,* and *Phaseolus*) were collected from various districts of the State and *Rhizobium* was isolated from each of them. Strains were kept in pure state and experimental plants were inoculated. The resulting nodulation was evaluated and studied.

Humification

In the scheme for research on 'Humification of organic matter in relation to the physico-chemical properties of soils' (at Agra College) Agra, with the objective of studying the physico-chemical properties of soil on humification of organic matter and to correlate the effect of artificial humification on the fertility status of soils in Agra district (which are very low in organic matter), the following generalisation regarding the variation in the physico-chemical properties of the 'Dumat' soils (brought about by the humification of

leguminous and non-leguminous weeds and plants) were made. It was, evident that the contribution of the mineralised nitrogen to the 'Dumat' soil by the non-leguminous weeds was appreciable, but comparatively lesser than that of the leguminous weeds and plants. In other words, the qualitative aspect of the humification of the Leguminosae and non-Leguminosae tended to be similar, but in quantitative aspect they may differ in the proportion of mineralised nitrogen contributed to the soil. It could be generalised that many non-leguminous weeds and grasses could improve the nitrogen content of the soils during humification. From the experimental results, it definitely followed that no line of demarcation could strictly be drawn between the leguminous and non-leguminous weeds and plants in regard to their manurial properties. The fertility status of the 'Dumat' soils of Agra district could be definitely improved by green manuring with the very many weedy plants that grow locally.

In the simple fertiliser trials in the scheme for 'Research on Manurial Trials, Bihar, conducted on the cultivators' fields' to find out accurately the response of fertilisers like ammonium sulphate and superphosphate in the different soil types of Bihar State, in all, 148 simple experiments on paddy and 150 experiments on wheat with N and P were carried out for three years at five centres (Arrah, Dumraon, Bikramganj, Sasaram, and Babua), out of which 142 experiments on paddy and 148 experiments on wheat were successful with N and P individually. The results are briefly given below:

Paddy

Taking the overall picture for all the three years, the average (control plot) yields in the descending order of magnitude were: at Bikramganj, 3016 lb., Dumraoh, 1938 lb., Arrah, 1796 lb., Sasaram, 1669 lb., and Bhabhua, 1017 lb., per acre. The average responses to nitrogen at 46 lb., per acre in descending order of magnitude were 640 lb. per acre at Sasaram, 535 lb. per acre at Bikramganj, 514 lb. per acre at Bhabhua, 415 lb. per acre at Dumraon and 405 lb. per acre at Arrah. The average response to phosphates at 40 lb., per acre level showed a progressive decrease in the order of 638 lb., acre at Sasaram 490 lb., acre at Bikramganj, 245 lb., acre at Arrah, 220 lb., acre at Bhabhua and 96 lb., acre at Dumraon.

Wheat

The average control figures for all the three years were 799 lb. acre at Sasaram, 692 lb. per acre at Dumraon, 564 lb., per acre at Arrah, 445 lb. per acre at Bikramganj and 443 lb. per acre at Bhabhua. Response to nitrogen at the rate of 40 lb. per acre was the highest at Dumraon (512 lb., per acre). In decreasing order of magnitude, Sasaram indicated response of 435 lb., acre. Bhabhua 308 lb., per acre, Arrah 342 lb., per acre and Bhabhua 308 lb., per acre. Response to P_2O_5 at the rate of 60 lb. per acre in the descending order of magnitude was 361 lb./acre at Sasaram, 311 lb./acre at Bhabhua 274 lb./acre at Bikramganj, 142 lb./acre at Arrah and 46 lb./acre at Dumraon.

Correlation between soil constituents and manurial responses

Soil samples collected from 0·3 ft. depth and 9·18 ft. depth from the control plots of all the experiments were analysed, and a

correlation between initial N and available P_2O_5 status of soils and their corresponding manurial responses was attempted. The co-efficient of correlation with respect to initial nitrogen content of the soils and the responses obtained with application of nitrogen of 40 lb. in the year 1952-53 was positive but insignificant. Similar correlation with respect to available P_2O_5 content of the soil and the response obtained due to the application of 40 lb. P_2O_5 was negative but insignificant for both paddy and wheat. During the year 1953-54, the co-efficient of correlation with initial nitrogen content and response to 40 lb. N was negative and insignificant for both paddy and wheat. Similarly, correlation with available P_2O_5 content of the soil and response due to phosphate application at 40 lb. was negative in the case of paddy and positive in the case of wheat but insignificant. In the third year *i.e.*, 1954-55, a positive correlation was obtained with paddy and negative with wheat in respect of initial nitrogen content and response due to 40 lb., nitrogen but insignificant. In respect of available P_2O_5 and the response due to phosphate at the rate of 40 lb. P_2O_5 co-efficient of the correlation was negative and insignificant in the case of paddy and negative but significant in the case of wheat. It was thus evident that the knowledge of initial nutrient status of soils in respect of nitrogen and available P_2O_5 cannot be a guide for predicting manurial recommendations. As such, true manurial recommendations can only be made on the basis of the results of field experiments.

Tuber Crops

Sweet potato (Ipomoea batatas)

Varietal collection: In Madras State, the varietal collections were made at Coimbatore and Mangalore. At Coimbatore, 64 varieties were maintained on the basis of their past performance; eighteen promising varieties and eight seedling types were selected for their comparative yield performance. At Mangalore, 127 types and crosses were under study and their morphological characters were recorded.

In Kerala State, three new varieties, *viz.*, F.A. 17 white, F.A. 17 Red and E.C. 4163 were added to the collection of sweet potato varieties, bringing the total number to 113. In all, 830 hybrid seeds were obtained from Japan and sown in the Ollukara sub-station. Of these, 630 had already germinated.

In Mysore State, a collection of 74 cultures was maintained at Hebbal.

Varietal trials : In Madras State, at Mangalore, F.B. 4004 (V8) and T.S.T. White (v. 12) gave the maximum calculated yields of 18,400 lb. and 17,424 lb. per acre during the first and second crop seasons respectively. In the past, two Chinese types, *viz.*, V2 and V6 and an American variety V8 proved to be consistently superior to 'Local' at Coimbatore, while at Mangalore three exotic types, *viz.*, V12, V8 and B219 proved consistently superior to 'Local'.

In Kerala, 61 intervarietal hybrids were tried and 27 hybrids were found to be better yielders than other local varieties.

In Bihar, at Sepaya station, 30 varieties were tested against Local. Varieties V8, V1, V26, V3 and V15 were found significantly superior to others. V8 gave a yield of 317·02 mds. per acre.

At Sabour (Bihar), V35 of I.A.R.I. varieties was found superior in yield to others. Local commercial variety proved superior to five American varieties.

The third clonal generation plants from the hybrid (L. X. Ranger) were tested against their parents. Cross 4 markedly out-yielded the parents.

In Orissa, five varieties of sweet potato were put under trial, but they did not show any statistically significant difference in yield of tubers. The five varieties B. 17 (V4), T.S.T. white, Ceylon, Cuttack and B. 4004 yielded 8,748·30 lb., 7,654·76 lb., 7,527·71 lb., 7,087 lb. and 6,806·25 lb., per acre, respectively, in descending order of merit.

Another yield trial with six varieties of sweet potato, including one local variety 'Narsingpur', was laid out. Yield differences were significant. Delhi-9 was the best of all.

In Mysore, ten varieties recently introduced gave 50 per cent more yield than Local. The heaviest yielders were 1-240 and B. 5999, which gave more than double the yield of Local *i.e.*, 4033 lb., per acre.

Under yield trials of exotic varieties and seedlings of sweet potato, 'Hosur Green' was found to be the heaviest yielder in all the trials and the difference in yield was significant over other varieties. It is a hardy variety and the storage roots are of attractive shape and size.

In the Punjab, under 'large scale' varietal trial, varieties, V2, V8, V6 and V3 gave increased yield over local type by 1770·0, 939·0, 917·6 and 111·6 per cent respectively. Under 'small scale' trials, varieties V2, V6, V18, V158, V12, V13, V8, V3, V9, and V44 gave increased yield over 'local' type by 381·5, 242·0, 197·2, 182·7, 163·5, 142·8, 129·5, 39·6, 21·6 and 13·5 per cent respectively.

Agronomical experiments

In Madras State, at Mangalore a spacing trial was laid out with the spacings, 2 feet, 2½ feet and 3 feet, between rows and 6 inches, 9 inches, and 12 inches between plants in the rows. Variety V8 was used for the trial. A maximum yield of 13,260 lb. per acre was recorded from the spacing of 3 feet between rows and 12 inches between plants during first crop season. During the second crop season, the maximum yield of 13,091 lb., per acre was recorded. It was also noticed that spacing influenced the size of tubes, which increased with wider spacings.

At Coimbatore, planting in furrows with 2½ ft. × 6 inch spacing gave the highest yield of 17,596 lb., per acre.

A trial "long vines" versus "short vines" was conducted at Coimbatore. Short vines recorded the highest yield of 26,452 lb., per acre as against long vines, which recorded a yield of 23,207 lb., per acre.

In Orissa, a cultural trial was laid out to determine the optimum spacing and right method of planting. The results did not show any significant difference between the treatments.

In Mysore, under cultural trial, a maximum yield of 3535·62 lb. was obtained in flat beds with rows 3 feet apart and plants spaced 12 inches in the row.

In the Punjab, under "Date of sowing-*cum*-manurial-*cum*-spacing trial" three sowing dates *viz.*, 16th June, 1st July and 16th July × 3 manures consisting of N, P and K × 3 spacings between rows *viz.*, 1 ft., 2 ft. and 3 ft., were tried. The first sowing increased the yield over second sowing by 28·2 per cent. Treatment N 50 lb. increased the yield over control by 36·4 per cent. Phosphorus and potassium did not show any response. Spacings of 1 ft. and 2 ft. increased the yield over 3 ft. by 43·0 and 17·4 per cent respectively.

Manurial trials

In Bihar, a manurial trial was conducted to test the effect of different organic and inorganic manures *viz.*, F.Y.M. and ash, both at 200 md. per acre and no manure and ammonium sulphate at 0 lb., 40 lb. and 80 lb. per acre, muriate of potash at 0 lb., 20 lb., and 40 lb. and superphosphate at 0 lb. and 40 lb. per acre. The effect of adding ammonium sulphate was to lower the yield. The effect of potash was significant.

In Orissa, a NPK manurial trial with three levels each of nitrogen and potash and two levels of phosphoric acid showed highly significant difference in all the treatments compared with the control. A basal dressing of compost or green leaf proved significantly superior to absence of basal dressing.

Miscellaneous experiments

At Coimbatore, under the 'Insecticidal trial' the performance of 'Findane' 5 per cent and D.D.T. (0·1 per cent) spray proved to be significantly superior to others.

Colocasia

In Orissa, a NPK manurial trial with two levels each of N, P_2O_5 and K_2O showed that there was no significant response to the application of any of the fertilizers applied singly. But the combinations of nitrogen and phosphoric acid, or potash and phosphoric acid or nitrogen, phosphoric acid and potash were all significantly different from the control. The combination of nitrogen with potash was, however, not significantly different from the control.

In the Punjab, under manurial-*cum*-spacing trial, four levels of nitrogen, *viz.*, N-0 lb., N-100 lb., N-150 lb. and N-200 lb. × 2 levels of phosphorus, *viz.*, P-0 lb., and P-50 lb., were tried under two spacings between rows *viz.*, one and a half feet and 2 feet. The dose of N-150 lb., was the most economical, giving Rs. 11·51 extra income over the control. Phosphorus did not show any response. One and a half feet spacing increased the yield over 2 feet spacing by 16·1 per cent.

Other tuber crops

In Bihar, research on other tuber crops, *viz.*, *Suthni* (*Dioscorea fasciculata*), *Haldi* (*Curcuma longa*), *Alti* (*Alocosia indica*), *Misrikand* (*Pachyrrhizus angulatus*), was in progress. Seven varieties of *Haldi* were tested against the local for tuber yields. Bangra 'A' significantly out-yielded all the varieties. Nitrogen applied at 60 lb., per acre was found to have significantly augmented tuber yield of *Alti*.

Under storage studies, it was noticed that tubers stored well when kept between alternate layers of sand and saw dust.

Tapioca

Varietal collection: In Madras, 52 varieties were maintained at Coimbatore. One variety, "Tirunelveli", formed tubers within 180 days. At Mangalore, 34 varieties were maintained. The varieties Chaum, Vellarotti, Malavella and Valenca were promising.

In Kerala, three more new varieties were added to the already existing collection of 305 varieties and 30 artificially evolved different chromosomal races were added. Two new varieties collected from Trichur district were found to be very different from the varieties so far grown.

In Orissa, out of four varieties under observation, Travancore White was the best and liked by the local people because of its whiter appearance and sweeter taste. Six varieties were collected from Kerala State for further trial.

In Mysore State, twenty-one varieties were maintained at the Agricultural Research Station, Mandya for study.

Varietal trials: In Madras State, the trials were conducted at Coimbatore and Mangalore. At Coimbatore, the variety 'Malavella' recorded the maximum yield follwed by 'Anaikomban' ; the per acre yields of the two were 9,075 lb. and 8,821 lb. respectively. At Mangalore, varieties 'Bassorica', 'Malavella', 'Kattan' and 'Travancore 105' showed some promise.

In the Punjab, under small-scale trial, variety T. 2 increased the yield over T. 1 by 157·8 per cent.

Cultural experiments: In Madras State, in the trial laid out at Coimbatore by planting sets taken from (1) the top one-third, (2) middle one-third, (3) basal one-third of the stem, germination was found to be very poor in the sets from the terminal ends of the stems.

In Orissa, a cultural trial to compare the ridge method of planting with the mound method of planting for ascertaining the optimum spacing showed significant difference between the treatments and the controls. Mound planting 4 feet × 4 feet was the best.

Manurial experiments: In Madras State, under manurial trial the effect of nitrogen only, proved to be significant. Nitrogen, at 50 lb. per acre gave the bighest increase in yield of 115·9 per cent over control.

In Orissa, under 'NPK' manurial trial, the effect of N, P_2O_5 and K_2O application with or without a basal dose of compost on the yield of tapioca was studied. The main effect of N, P_2O_5 and K_2O was significant, but none of the interactions was significant. The basal dose of 4,000 lb. of compost per acre did not make any material difference in the yield of tapioca.

In the Punjab, under manurial trial, treatments N-50, P-50 and N-100, P-50 gave lower yield than control—which showed that tapioca crop did not respond to nitrogenous and phosphatic fertilizers.

Vegetables

In order to effect all-round improvement in vegetables, various investigations relating to varietal tests, cultural practices, hybridisation and breeding for better types and disease-resistant varieties, were carried out in various States *viz.*, Punjab, Himachal Pradesh, Uttar Pradesh, Andhra Pradesh, Bombay, Madras and West Bengal.

Brinjal

At the Central Vegetable Breeding Sub-Station, Katrain, varietal performance showed that three varieties of brinjal namely, 'Pusa Purple Long', 'Pusa Purple Round' and 'Pusa clustered' were promising. The first two of these three varieties did well in the plains as well as hills, but 'Purple clustered' was especially suitable for the hills. Its clustering habit was conspicuous.

In Madras State, under yield trial, two selections S.M. 8 (Giant of Banaras) and S.M. 6 (Black Beauty) were found to be superior and gave yields of 14,520 lb. and 9,556 lb. per acre respectively.

Insecticidal trials against the shoot and fruit borer (*Leucinodes orbonalis*) were conducted at Coimbatore. The treatments D.D.T. 0·1 per cent, Dieldrin 0·1 per cent and Folidol 0·025 per cent reduced the borer incidence on shoots and fruits of brinjal.

At the Government Vegetable Research Station, Kalianpur (U.P.) 24 long-fruited, 23 round-fruited and 15 light-green fruited cultures were retained at the Station for further testing. They were classified on the basis of their maturity and fruiting habits. One long-fruited variety (Melate) with violet-purple colour was very much liked by the customers for retaining its freshness for a longer period than the purple-coloured varieties.

Bhindi

At the Government Vegetable Research Station, Kalianpur (U.P.), 45 selections were retained on account of their desirable characters and better performances. These include 19 early, 15 medium and 11 late varieties according to their maturity. The selection 5303-1 L(R), II-50-1-1-1 L. 91-50-1 and 5114-3-1 were found to be superior than others.

In Bombay State, experiments on breeding for resistance to virus disease at Poona indicated that F_3 progenies of three accession lines, *viz.*, 318, 319 and 326 were showing high degree of resistance and were isolated for further studies.

In Andhra State, 25 varieties were tried and only four *i.e.*, Shankerpalli, Red Wonder, Lucknow 5114 and Gujarati were found promising.

In West Bengal, a trial with three varieties and four times of planting was carried out at Krishnagar. The analysis of variance showed that time of planting was significant at 1 per cent level of probability. T2 (15·4·55) was superior to T1 (15·3·55), T3 (15·5·55) and T4 (15·6·55).

Tomato

At the Central Vegetable Breeding Sub-Station, Katrain, the American variety 'Sioux' was observed to be early and a good yielder.

In West Bengal, under varietal trial, the variety Hybrid No. 4 was found to be superior over others in yield. It matured within 68 days of transplanting and gave a yield of 6 lb. per plant.

In the Punjab, a small-scale trial was laid out on 36 collections, out of 42 previously collected. Hybrid 12 from I.A.R.I. topped the list in yield.

In fertiliser trial, 80 lb. Nitrogen plus 40 lb. P_2O_5 gave significantly higher yield, over 60 lb. N plus 40 lb. P_2O_5, 40 lb. N plus 40 lb. P_2O_5 and the control.

In Bombay, a few fresh seeds of selected tomato varieties from I.A.R.I. and two new strains of tomato, *viz.*, 53·548 and 'Solid Red' from U.S.A. were obtained for making selection of tomato varieties for breeding purposes. Seven selections were made on the basis of yield, low susceptibility to virus disease and keeping quality. They would be used for breeding for resistance to virus disease. The two pink varieties, *viz.*, 'Summer Prolific' and No. 1085 showed the best keeping quality. Fifteen crosses between the selected tomato varieties and other wild relatives, *viz.*, *Lycopersicum pimpinelli-folium* and *Lycopersicum peruvianum* were successfully made.

In Madras, H. 123 (Meeruti) recorded the highest yield of 6,589 lb. per acre.

In the Punjab, among the varieties tried 'Meeruti' and 'Pondersa' were found to be superior to 'Sioux' and 'Margloble' but were on par with each other. In spacing trial, 2 feet × 1½ feet gave 41·01 per cent more yield over 2 feet × 2 feet spacing (local).

Cauliflower

In West Bengal, four types of midseason cauliflower were tried at Krishnagar. 'Dania' proved better than others and gave an average yield of edible head of 12·6 oz. per plant. At Kalimpong, trial was laid out with five varieties of midseason cauliflower. Varieties 'Snowball and 'Dania' were significantly superior at 1 per cent level over Desi, Terminal Snowball and American type. Average weight of each edible head was 2·08 lb. in Snowball and 1·9 lb. in Dania. It took 62 days for Dania and 76 days for Snowball to reach maturity from the date of transplanting.

Cabbage

In West Bengal, seven types of cabbage were put to varietal trial under two different groups, early and midseason. Under the early trial, Golden Acre and Prize Winner were superior over others with an average yield of 1·97 lb. per head. In the midseason trial, Eclipse Drumhead gave the maximum size of heads with an average yield of 4·59 lbs.

In Himachal Pradesh, twenty-five varieties comprising groups Kakefield, Copenhagen Market, Drum head, Danish Ballhead and Savoy were put under trial. On the basis of purity, size, shape and firmness of the head, five varieties were selected for further trial.

Pea

At the Central Vegetable Sub-Station, Katrain, 'Early Badger' amongst the early pea varieties and 'Lincoln' or 'Greenfeast' (Darantia Kaip) and 'Kanawari' (the smooth-seeded Simla Matar) amongst the midseason pea varieties were promising. The Madhya Pradesh variety (Khapar Kheda) and the Bihar variety B. R. 12 also did well.

In West Bengal, a varietal trial with eight types of pea was laid out at Krishnagar and 'Bonneville' was found to be superior over others. Its pods were well filled and medium sized. At Kalimpong an early variety, 'Giant', was superior over others in having bigger pods and bolder grains, which were sweeter in taste.

In Himachal Pradesh, a trial was laid out with 33 varieties and six varieties were selected for further trial on the basis of their seed and pod-size, uniformity, etc. The yield of these selections as recorded on the basis of 10 ft. rows was as follows:

N. P. 29 and Delwichee Commando (both from I.A.R.I.) 6 lb., each ; Bonneville (I.A.R.I.) and Invincible Marrow-fat (N. Cooper), 5 lb., each; Early Badger (I.A.R.I.) 4 lb., 'Green' 2 lb. 8 oz., 'Hari Chhal' and Radio 2 lb. each.

Onion

In Himachal Pradesh, an agronomical trial was laid out with 18 varieties; 2 to 5 rows were given to each variety. The spacing was 1 foot between rows and 9 in. between plants. Four were selected for further trial on the basis of size, weight, colour, thinness of neck, and uniformity of the bulbs. In these, the average diameter of bulb varied from 3·0 cm. in 'Bombay Red' (Globe Nursery) to 60 cm. in 'Red Globe' (New Model Seed Farm). The average weights per bulb were 'Red Globe' (2·60 oz.), 'Poona Red' (1·75 oz.), 'Golden Ebenezer' (1·0 oz.), and 'Bombay Red' (0·75 oz.).

At the Government Vegetable Research Station, Kalianpur, (U.P.), seeds raised last year from 131 bulbs of red round, 154 of red flat, and 42 of white selections, along with 11 new samples, were sown for further selection of bulbs. Selection was made on the basis of bulb shapes—round or flat, colour and keeping quality, etc. In all, 535 bulbs of red round, 513 of red flat, 20 of white round and 20 of white flat were retained for detailed studies.

In West Bengal, an experiment with two varieties and eight times of transplanting was conducted at Krishnagar. September transplanting was significantly superior in yield.

Beans

In Andhra Pradesh, a varietal trial with five varieties of French beans and six replications, was carried out. 'Canadian Red' and 'Premier' were found to be on par with each other but were superior to 'Ashgrow Stringless'.

In Himachal Pradesh, forty-four varieties of French beans were compared, of which 11 varieties were selected for further trial on the basis of beaning, size of pod, uniformity and other economically important characters.

Gourds

At the Government Vegetable Research Station, Kalianpur (U.P.), two selections of muskmelon (a) yellow-orange skinned with orange-coloured flesh and (b) yellow orange-skinned with white flesh (the real Lucknow 'Safeda') were found sweetest of all the other selections. Two rough-skinned musk-melon selections (a) dark brown netted, rough-skinned with orange-coloured flesh, and (b) light green-skinned with deep-green streaks and light-green flesh were also promising.

One variety of sponge-gourd (5235-2-1) and one of ridge-gourd (5312-1-1) were found to be quite satisfactory.

Leafy vegetables

In order to improve the yield, quality, earliness and disease resistance, etc. of leafy vegetables, the work on *methi* (*Trigonella foenum-graclum L.*), *Palak* (*Spinacea oleracea L.*) *Chakvat* (*Chenopodium album L.*) and *Rajgira* (*Amarantus paniculatus L.*) was in progress in Bombay State.

At Poona, selection Nos. 4, 27, 45, 8 and 14 (*methi* for leaf) were promising. No. 8 showed a higher vitamin 'C' content, being 166·6 mg. 100 gms. For seed purposes, selections Nos. 40, 25 and 64 gave the highest yield over the local. In *Palak*, selection Nos. 51/17, 56/8 and 50/21 were significantly superior over the rest. Selection No. 56/8 gave a high vitamin 'C' content, being 58·5 mg./100 gms. In *Chakvat*, selection Nos. 14, 4, 9 and 20 were promising. Selection No. 4 showed a high vitamin content, being 102·3 mg./100 gms.

Fruits

Mango

At Hyderabad Fruit Research Station, blossom-biology studies were conducted in 23 varieties. Banganapalli was the earliest to flower. The earlier to be harvested was *Sufeda*, and *Mahmooda* was the last. Goa-Bunder gave a maximum yield of 2,715 fruits weighing 1,010 lb. Pittue recorded the highest percentage of hermaphrodite flowers of 47·1.

Under varietal collection, thirty varieties were collected from five States, bringing the total number of varieties to 217.

Citrus

Research schemes were in progress in the Punjab, U.P., Andhra Pradesh, Bombay and Orissa.

Varietal collection: In Andhra Pradesh at Hyderabad, 24 citrus varieties of different species were planted, including seedless Bibile Orange from Ceylon. Oranges Malta, Hamlin, Pine-apple and Hazara, Kumquat varieties, *viz.*, Marumi and Nagami were added to the collection; Vadlapudi orange failed to be established.

In Mysore State, at Chethalli, Oddermotte (Coorg), citrus varietal collection was made from U.S.A. and Assam for trial. They were *Citrus hystrix*, lime-quats, citrange-quat, Rangapur lime, lemons, sweet oranges (Hamlin, Rubby blood, Jaffa, Kothean sweet, Hamassasa, Parson brown and Kodur sathgudi) Mandarins (Dancy, Clementine and Khasi), grape fruits (Marsh and Secily). Their growth performance was satisfactory.

Varietal trials: In Himachal Pradesh, in order to lay out a regular varietal trial with important varieties of sweet oranges, the six most important varieties, namely, Blood Red, Pine-apple, Valencia Late, Jaffa, Hamlin and Mosambi were budded on Jamberi rootstock at the Fruit Research Sub-Station, Dhaula Kuan, for further trial.

Rootstock trials : At the Fruit Research Station, Anantharajupet (Andhra State), rootstock trials were conducted on Sathgudi orange. Jamberi was leading over the rest of the rootstock, *viz.*, Kichili, Sathgudi and acid lime.

In the acid-lime rootstock trials, there was no significant difference between plants on different rootstock in fruit-yield by weight. The rootstocks also had little or no effect on the fruit quality as judged by juice content or acidity.

In the lemon (Nepali oblong) rootstock trial, the budlings on acid lime were leading over the rest in the growth characters. The rootstock Gajanimma recorded the maximum tree-height, while there was no significant difference in tree-spread and volume between the different scionic combinations.

At Hyderabad, budded plants of Mosambi orange of eight rootstocks were prepared for the ensuing rootstock trial. Only six would be utilised in the trial.

In Bombay, at Tharsa station, under rootstock trials, girth measurements indicated that Jamberi, Jatti Khatti and sweet lemon rootstocks had greater influence on the vigour of *Santra* scion than the remaining rootstocks.

Santra trees on Rangpur lime bore significantly higher crop than on other rootstocks.

In Himachal Pradesh, at Dry Fruit Research Sub-Station, Chini, eight rootstocks, *viz.*, Karna Khatta, Jatti Khatti (Rough Lemon) Kimb (Sour orange), Jamberi (Rough Lemon), Galgal (Hill Lemon), Mitha (Sweet Lime), Malta (Sweet Orange) and Nasnaran were put under

trial. But as Nasnaran failed to germinate and the seedlings of sweet orange did not attain proper size, the seedlings of the first six rootstocks were budded in June, 1956 with the three section varieties namely, Blood Red, Pine-apple and Valencia Late. The seedlings of sweet orange would be budded later on.

Manurial trials : In Bombay State, at Tharsa Station, fertilizers —organic and inorganic, were applied to *Santra* trees. The data showed no significant difference either as recorded by girth measurements or by volume of the tree. No significant differences were observed regarding the yield performance also. There was, however, considerable variation in tree-to-tree yield which ranged from 15 to 2500 fruits per tree.

The physico-chemical analysis of fruits under various manurial treatments was carried out, but no manurial effect was reflected in the chemical composition of *santra* fruit.

Banana

In order to effect all-round improvement of banana crop by introducing better varieties and evolving better cultural practices, work was in progress at the Central Banana Research Station, Aduthurai (Madras State) and two sub-stations, Ganeshkhind Fruit Experimental Station, Poona (Bombay State) and the Banana Research Station, Chinsura (West Bengal).

At Ganeshkhind Fruit Experimental Station, Poona, six varieties were added to the collection, bringing the total collection to 105, comprising 77 table varieties, 16 cooking varieties, 11 wild types and 1 unknown. The varieties, Mendol, Belu Kanch Kela, Sansara-bali, Hazari and Ney Poovan were promising.

The studies on the utility of bits of corms as planting material showed that 2 lb. and 3 lb. whole rhizomes planted in pits were significantly superior over 4, 3 and 2 lb. bits planted in shallow furrows. In growth measurements, the March planting gave significantly better performance than the plants planted in June.

From the growth observations, recorded 9 months after planting, it was observed that the plants spaced at wider spacing gave significantly superior performance over those spaced closer.

In West Bengal, under irrigational trials, the treatments applied were (a) without irrigation, (b) irrigation at interval of one month *i.e.*, in November, December, January, February, March, April and May (c) irrigation at interval of two months *i.e.*, in November, January, March and May, (d) irrigation at an interval of three months, *i.e.*, in November, February and May. The treatment without irrigation gave the poorest height and girth measurements of all, and at shooting there was no significant difference among the other treatments.

Leaf count was found non-significant among different treatments at shooting. The total leaf production was, however, the highest in

the treatment with monthly irrigation. There was no significant difference among treatments without irrigation and with irrigation at intervals of two and three months. There was also no significant difference among the treatments in respect of suckers produced, number of days taken to shoot and in the average number of 'hands' and 'fingers' per bunch.

The work on breeding of improved types of banana carried out at the Calcutta University from 1947-51 gave some very important practical observations of utmost use to the breeders. The studies revealed the highest degree of fertility of *M. paradisica* diploids and their complete crossability between all sub-sections. Other species in the same sub-section may not cross with other subgenera and even within their own subgenera, but *M. paradisica* crossed with other Eumusa, with *M. agharkari* (Physocaulis) and *M. yubra* (Rhodochlamys) yielded innumerable seeds each time. This species helps to link up, as it were, all sections of the *Musa* genus.

It has also been observed that a more fertile plant should be taken as the female in a cross to ensure its success. Often a reciprocal cross taking the fertile one as female has been successful where the other cross has failed. In reciprocal crosses the phenomenon of cytoplasmic inheritance was noticeable.

In the case of crosses attempted, the fact emerges that as long as the clone is fertile, no matter how derived, it can stand crossing with another fertile form, preferably of like chromosome number, whatever be the origin of that form. Thus the possibilities of banana breeding are immense, for as soon as a clone is successfully struck, that form becomes available for use to man.

Cashewnut

Varietal collection: In Madras State, at the Central Cashewnut Research Station, Mangalore, four samples of seed from Portuguese East Africa and British East Africa were sown in June, 1956, bringing the total number of cashew selections under observation to 109. The seedlings of seven selections from Malabar, South Kanara and Tanjore showed the maximum degree of uniformity in plant-height and stem-girth.

In Andhra State, at the Cashew Research Station, Bapatla, there are already 260 seedling trees of about 20 years' age. A detailed survey of existing orchards in Srikakulam, West Godavari and Guntur Districts was undertaken and thirty outstanding trees were selected for further trials.

Standardization of vegetative propagation methods : In Madras State, air-layering shoots through the method of cincturing, using alkathene wrappers, continued to be a promising method both with one-year old and current seasons shoots. In addition to this, the following observations were made at the Station:

(i) Shoots in trees below 10 years of age have a tendency to produce roots earlier than those in older trees ;

(ii) Treating the cinctured portion with growth-promoting substances resulted in slightly higher percentage of success, particularly

during June and July, when the rooting is poor in the normal method, and

(iii) Cincturing at the node induced earlier rooting.

In order to observe the responses of air-layering as a commercial practice, 4,000 layers were prepared between March-May, 1956. Of these, 2,500 were successfully separated till the end of June, 1956.

Blossom biology: In Madras State, the observations showed that cashew pollen was viable for 48 hours. Sixty per cent of pollen grains of the anthers in the staminate flowers, and all the grains of anthers in the bisexual flowers were fertile. The pollen grains in short stamens were found to be sterile. Pollination tests showed that cashew is self-fertile.

Another special study showed that good yields in trees known for their regular and heavy cropping tendencies and poor yields in shy and poor bearers were both found to have a definite relationship to the percentage of bisexual flowers, which was high in the former and very low in the latter.

In Andhra State, it was observed that there was a strong wave of lush growth and flowering in January-February which was the main flowering season in cashew, during which time over 90 per cent of the shoots grow and flower.

The shoots that flowered renewed growth-activity at the end of the fruiting season in May-June.

Guava

At the Fruit Research Station, Hyderabad, a tree of Kohir gave a maximum yield of 2,462 fruits weighing 426 lb., 11 oz.

A survey of serious disease on guavas in various orchards in Ajmer showed that the disease is caused by zinc deficiency. Foliage spray with different chemicals was done in different orchards. Out of all these, only zinc sulphate gave encouraging results.

Custard apple

In Andhra Pradesh, at Hyderabad Fruit Research Station, Mammoth was found to be the best yielder among all the varieties of Sitaphal. Cherimoyer gave the maximum yield among all the species of *Anona.*

Trials on root cuttings of Sitaphal did not give any encouraging results. Budding was found to be the cheapest and most successful method of propagation in Anonaceous fruits.

Two thousand nine hundred and fifty-four crosses with 18 combinations between different species of *Anona* were made. Three hundred and nineteen hybrid seeds were obtained ; 23 seedlings resulted from the crosses between Cherimoyer and *Anona glabra.*

Grape-vine

At Hyderabad Fruit Research Station, 116 varieties were collected from U.S.A. and all over India. Sixty-seven varieties bore crop.

Anab-e-Shahi was declared as the best variety in the All India Grape Show at Hyderabad.

Ten thousand and ninety-five crosses were made. Nine hundred and nine berries were produced, giving 486 hybrid seeds of 36 parental combinations. Twenty-seven seedlings of F_1 progeny of 1952-54 crosses were growing satisfactorily. Out of 833 hybrid seeds of 1954-55 treated in a refrigerator at 0 degree C. for one month, 37 germinated.

Papaya

At the Government Fruit Research Station, Saharanpur (U.P.), to stabilise and purify the types of papaya, in-breeding was carried out in 24 promising types selected earlier. Out of these inbred lines, 10 types completed four rounds of line-crossing. There was considerable variation in the shape and size of fruits of the inbred progeny of a type and no fixed period could be prescribed for the attainment of maximum homozygosity in them.

Ber

Research schemes were in progress in the Punjab, Madhya Pradesh and Bombay.

At the Government Fruit Research Station, Bahadurgarh, (Pb.) the seedlings of six distinct types of rootstocks *viz.* P. Z. S. S. 1, P. Z. S. 2, P. Z S. 3, P. Z. S. 4. P. Z. S. 5 and P. Z. S. 6, which were raised in pots, were transplanted in the field. As soon as the plants established their root systems, height measurements were made in order to study the comparative rate of their growth. The following observations were made :

(i) Stock P. Z. S. 5 was leading, as in pot-culture during last year, and was the most vigorous stock.

(ii) Stock P. Z. S. 3 gave better growth in field and was just as good as stock P. Z. S. 5.

(iii) Stock P. Z. S. 1, P. Z. S. 2 and P. Z. S. 4 were of average vigour, and

(iv) Stock P. Z. S. 6 was least the vigorous.

The pulp percentage of ten commercial varieties of grafted *Ber* was worked out at the station with the following observations:

(i) Umran excelled all the varieties in the percentage of pulp—the percentage being as high as 96·4.

(ii) Umran was followed by Kaithli, the percentage being 95·2.

(iii) The rest of the varieties were also rice in pulp percentage, ranging between 91·9 to 94·6.

Date palm

In the Punjab at Abohar, a research scheme for the improvement of date palm was in progress. Eighty-four suckers of three varieties, *viz., Hillawi, Khadrawi* and *Shamran*, were collected from within the

country. Seventy-two suckers of three varieties *viz.*, *Hillawi, Khadrawi* and *Asli* were received from Khairpur State (W. Pak.). Fifty offshoots of five varieties—*Hayani, Zagloul,* Samani, Amhat and Gandilla were imported from Egypt for trials.

Apple

Varietal collection : In Himachal Pradesh, at Fruit Research Station, Mashobra, 38 varieties of apple were introduced from U.P., Kulu and Simla Hills, bringing the total number to 224.

In Kashmir, four plants each of twelve important commercial varieties of apple were obtained from Kulu (Punjab), Mashobra (near Simla) H. P., and Chaubbattia, U.P. In addition to this, four plants each of 19 varieties of apples were obtained from the local Government nurseries. The trees of these varieties were planted at the Kashmir Provincial Agricultural Experimental Farm for trial purposes.

Varietal trials: At the Fruit Research Station. Mashobra (H. P.) a trial was laid out with eight commercial varieties of apple namely Ambri, Royal Delicious, Red Delicious, Golden Delicious, Cox's Orange Pippin, Baldwin, Ranny Smith and Rus Pippin, replicated four times. Girth records of individual trees of all the varieties were taken and analysed statistically. The differences in total girth and annual increase were found insignificant.

Rootstock trials : At the Fruit Research Station, Mashobra (H. P.) the rootstock material for this trial was prepared and multiplied by stooling from nucleus material imported from England and planted at the Station. The number of different clonal rootstock seedlings in hand was 269, comprising 18 of M. II, 59 of M. XII, 109 of M. XIII, 21 of M. M. 108, 56 of M. M. 110 and 7 of M. M. 112. The propagation studies and resistance to wooly aphis of these stocks were under study.

In Kashmir, two dozen plants of each of the rootstocks *viz.*, M. II, Merton, 778, 779 and 789 were procured from the Fruit Research Station, Chaubattia (U. P.) and planted. These would be multiplied by stooling and layering and utilized for preparation of plant material for apple and rootstock trial.

Manurial and fertilizer trial: At the Fruit Research Station, Mashobra (H. P.) the data on girth measurements were analysed and did not show any significant difference in the girth increase in the trees under different treatments *i.e.*, control, 2 lb. lime per tree and 4 lb. lime per tree, after one year of orchard life.

Propagation trial: At the Fruit Research Station, Mashobra, (H. P.) a propagation trial on apple was carried out at different times of budding, *viz.*, June, July, August and September, and two times of grafting *viz.*, January and February. The results showed that (i)

budding in June and grafting in February gave the highest percentage of success, which was significantly higher than the success obtained in other months. The difference bewteen the former two treatments was, however, not significant. (ii) Budding in July and August gave significantly better results than budding in September and grafting in January, the difference in the former two treatments being statistically not significant.

Pomegranate

In the varietal collection at Hyderabad, one more variety, Bassein from Bangalore was added.

Chestnut

At Fruit Research Station, Mashobra (H. P.), germination trial of chestnut seeds were carried out with two storage media *viz.*, sand and moss grass and four sowing-times *viz.*, November, December, January and February. It was revealed that sowing of seeds after storing them in moss grass for two months gave the highest germination and January sowing gave the best results. When stored in sand, December sowing was the best.

Plum

Studies in line-pattern disease of plum in Kumaon hills showed that the disease was transmissible by budding and grafting to peaches and plum. The disease was also observed on Maynard varieties and Japanese plum.

Peach

Necrotic ring-spot of peach was noticed only on white peach in Kumaon hills.

General

A short reorientation course for the benefit of trainees from various States was organised at the Central Cashewnut Research Station, Mangalore, with the collaboration of the Madras Government, for adding to the technical knowledge on the cultivation of cashewnut. To step up production of cashewnut in the country, development schemes were sanctioned in the States of Kerala, Mysore, Orissa and Madhya Pradesh. An all-India show of spices and cashewnut was held at Cannanore, to give impetus and encouragement to the growers of these crops.

In the scheme for the extension of cashewnut cultivation in the forest areas, Madras State has brought an additional 9,000 acres under this crop, thereby exceeding the target for the year by about 500 acres.

In the scheme for the development of pepper in Madras, selection was made of over a lakh of heavy-yielding pepper vines and 40,000 cuttings of these types have been distributed to the growers.

A scheme for the development of turmeric cultivation has been sanctioned in Orissa, and the scheduled tribes living in that area will be largely benefited.

Preservation and Storage of Fruits

With a view to avoid serious losses in storage and transportation of fruits, studies were made on important fruits such as mango, orange, banana and apple at Mysore, Kulu, Poona and Saharanpur, using fungicidal emulsion as treatment.

In Mysore, at the Central Food Technological Research Institute it was observed that 6 per cent is the optimum strength of fungicide for different fruits. Large-scale trials on mangoes showed that the fungicidal wax emulsion could be used with advantage commercially.

At Kulu, the trials showed that in long transits, losses could be reduced by 6 per cent to 12 per cent in the fruits treated with fungicidal wax. Organoleptic tests showed that the treated fruits were better than control, both in appearance and taste. The losses in weight were also significantly less than the control.

At Poona, the trials on *Basrai* and *Harichal* varieties of banana were conducted in three different seasons (*i.e.* in July, November, and January) using three different concentrations (from 2 to 4 per cent) of the waxy emulsion. It was observed that the keeping quality of the fruits was improved to some extent, without affecting the organoleptic quality, but storage life was not appreciably increased. Similarly, Alphonso and Pairi varieties of mango were treated with 4 to 7 per cent concentrations of the emulsion and gave better appearance, good taste and flavour, as observed after 13 days of the treatments. But increase in storage life was negligible. Concentrations higher than 7 per cent affected the quality and ripeness adversely. At Saharanpur, the experiments were conducted on three varieties, *viz. Dashehari, Kakran Sajampur* (K. S. Pur) and *Langra.* There were 8 different treatments, 7 different concentrations of Dr. Sharma's waxy composition, and the control (no treatment) ; losses were the least with 6 per cent. *Dashehari* had the maximum loss and *Langra* the least. No effect was observed on acidity, total soluble solids and quality of the fruits.

Chemical composition and nutritive value

Analytical researches on fruits and vegetables were in progress at the Nutrition Research Laboratories, Coonoor, in order to evaluate their nutritive value.

Investigation of micro-nutrients

At the I.A.R.I., in order to study the role of micro-nutrients in plants, the purity of autoclaved and re-crystallised salts was tested directly on quick-growing plants such as maize and tomato.

In maize, the boron deficiency symptoms were characterised by white stripes on the leaf blade.

In tomato, boron deficiency resulted in the death of growing points and brittleness of petioles, leading to their sudden collapse. Mottling of the leaf, brown pin-points scattered all over the lamina and shedding of flower buds were characteristic of manganese deficiency. Zinc and copper deficiencies only stunted the growth in both tomato and maize.

In mandarin seedlings raised from seed, dieback of the shoots occurred with manganese and boron deficiencies after eight months from the start of these trials. The manganese-deficient cultures developed two patterns of chlorosis—an interveinal pattern where distinct bands of yellow appeared between the veins, and the young leaves showed a fine pattern of green veins on a lighter green background. Under boron deficiency, the terminal leaves were very pale and leaf-size reduced. It was also noted, under this deficiency, that the lower side of the midrib assumed reddish-brown colour simulating corky formation ; this symptom is more prominent on chlorotic leaves. Under manganese deficiency, though the leaf production received a set-back, the size was unaffected. Under zinc and copper deficiencies, growth was stunted and leaf-size reduced.

With regard to major nutrient deficiencies of N, P and K in cultures planted to 'Mosambi' buddings, crinkling of leaves and scorching starting from tips and margins were characteristics of potassium deficiency. Cup-shaped yellow leaves, reduced in size, were characteristic of nitrogen deficiency. Under both these deficiencies shedding of leaves took place. Phosphorus-deficient cultures did not exhibit any characteristic symptom except that the plants were slightly stunted as compared to the control cultures.

All India fruit shows

To disseminate information about the varietal wealth of different fruits grown in India for the benefit of the horticulturist, the plant breeder, the fruit grower and the public at large, shows of different fruits were organised by the Council. The first All India Mango Show for Southern varieties was organised in Bombay during May. 1955 ; 175 exhibitors participated and 104 prizes were awarded. Nearly 200 varieties of mango and 1,500 exhibits were put on display.

In Delhi, the First All India Mango Show for Northern varieties was also organised in July, 1955; 350 exhibitors participated and 117 prizes were awarded. Nearly 250 different varieties and 3,000 exhibits were put up for display.

The First All India Grape Show was held at Hyderabad in March, 1956. Nearly 225 exhibitors participated in the show and 46 prizes were awarded. Fifty-eight varieties and 800 exhibits were put up for display.

Agricultural Implements

The survey of indigenous agricultural implements has been completed in almost all the states and the All-India Report of the Survey is being compiled on the basis of the State Reports of the Survey.

The Council has sanctioned a scheme for the award of prizes for making improvement in 15 selected agricultural implements. About 107 machines have been entered in the competition for the award, and necessary trials are made with these machines through the State Departments of Agriculture. The reports regarding the trials have so far been received from the States of Punjab and Pondicherry. No entries for the award were registered in the States of Assam, Andhra and Orissa. The reports are awaited from the remaining States.

CHAPTER III

ANIMAL HUSBANDRY RESEARCH

Cattle Breeding

Livestock Investigation Scheme, Hissar (Punjab)

The scheme was started at the Government Livestock Farm, Hissar in April, 1943 with the object of investigating the possibilities of evolving a dual-purpose Hariana animal combining the two economic characters, *viz.*, draught ability and milking capacity by scientific breeding. During the year under report, 17 cows of the foundation stock and 194 of F_1 generation were mated to the selected bulls. The over-all percentage of fertile services worked out to 56·2 per cent. The bulls did not significantly differ from one another. The average time taken by the bulls in serving a cow varied from 19 seconds to 48 minutes 17 seconds with an over-all average of 18·7 minutes. The difference in the mean reaction time of bulls was found to be significant at 5 per cent level. Out of the 91 normal births, 51 were males and 40 were females. The sex ratio as calculated for the last 11 years, covering 1951, further worked out to 127 males born for every 100 females. Average birth weights of calves for different age-groups had been worked out. The data compared favourably with the over-all averages recorded from the inception of the scheme. A study of the milk records revealed that there was an increase in production during the past seven years. A study of the lactation records since the inception of scheme showed that 8·2 per cent cows yielded 3,000 pounds and above, and 27·8 per cent between 2,000 to 3,000 pounds, and 45·6 per cent between 1,000 to 2,000 and 18·4 per cent below 1,000 pounds. The yields of 97 cows which completed lactation during the year ranged from 1,417·2 pounds to 3,076 pounds. The lactation periods ranged between 249·9 to 294·0 days. The average calving interval was recorded as 434·43 $\pm$14·3 days as compared to 574 $\pm$ 46·45 days during the previous year. The study of effect of season on fat percentage in milk was continued. The studies based on 617 records revealed that the fat percentage was maximum (4·3 per cent) during winter and minimum (3·9 per cent) during spring and summer seasons. This confirms the previous year's findings. The analysis of variance showed that significant differences in fat percentage existed between the seasons.

During the year under report, the heritability of milk yield based on the study of 96 daughters worked out to $65 \cdot 8 \pm 6 \cdot 1$ per cent. The heritability of calving interval as calculated by the intra-sire dam-daughter regression method based on 52 cases, worked out to $40 \cdot 0 \pm 11 \cdot 05$ per cent. as compared to $42 \cdot 2 \pm 18 \cdot 5$ per cent during the previous year.

Preliminary trials with dynamometer cart to determine the draught ability of the bulls were undertaken on four bullocks selected for the purpose. Data on various aspects of the experiment were being collected.

During the year under report, the herd was found free from tuberculosis and brucellosis, though in the previous years these diseases were encountered in the herd. In all, 47 cows were examined for infertility. Of these, 3 were treated for persistent corpus luteum, 4 for cystic ovary and 36 for anoestrus ovary. The mortality figure in the herd stood at 3·4 per cent., as compared to 3·6 per cent of the previous year.

Improvement of Kangayam breed, Palayakottai, Madras

The scheme was started in July, 1942, at the Palayakottai Farm (Madras) with the object of improving milking capacity of Kangayam cows without adversely affecting the draught capacity of the males of the breed. The work on the draught capacity continued under the committee of experts, as reported in the previous year.

This year also, certain difficulties were experienced while pairing the selected bulls and putting them to the yoke. The animals were, therefore, paired with non-experimental bullocks of the same age and body-development. The average age of maturity (first calving), based on 16 heifers which calved during the year, was recorded as 43 months. As a result of pre-natal massaging, average daily milk-yield rose to 6·2 pounds, as compared with 5·2 pounds in the control group. The average lactation length for the experimental group was 273 days as against 219 days for the control group. During the year under report, 60 cows of the foundation stock and 134 of the progeny completed their lactation. The milk yield was recorded once a week, both in the morning and evening, by complete stripping of the udder. A study of lactation records revealed that 6 cows of the progeny and 16 of the foundation stock yielded 2,000 pounds milk and above in a lactation; 35 cows from the foundation stock and 29 from the progeny yielded between 1,000 and 2,000 pounds, and 9 cows from the foundation stock and 9 from the progeny yielded below 1,000 pounds. Eighty-nine animals were either discarded or sold due to various reasons. The average fat percentage of the progeny cows was 5·4 per cent and of the foundation stock, 4·7 per cent.

During the year under report, 105 calves were born, of which 49 were bull calves, 55 heifers and one was still-born. The average birth-weight of bull calves was 44·2 lb., and that of heifers, 42·2 lb. The average per day increase in weight was recorded as 0·8 lb. Feeding was the ration prescribed by the Council, but the ratio of concentrates was changed from time to time according to the availability of grazing during various months. Sixty breeding bulls were distributed from the stock to the Key Village Schemes, Artificial Insemination Centres and Bull Distribution Scheme. Ten thousand one hundred and ninety-three artificial, and one thousand nine hundred and sixty-one natural, services were given by these bulls.

Selective breeding versus *grading up, Purnia (Bihar)*

The scheme came into operation in January, 1956. The object of the scheme is to test the relative value of selective breeding of Red Purnia cattle and their up-grading with Red Sindhi bulls with

a view to increase milk-yielding capacity without adversely affecting their draught ability. Red Sindhi bulls have been purchased and the land for the proposed farm has been acquired. Steps are being taken to purchase the foundation stock of Red Purnia cattle.

Similar schemes on selective breeding *versus* grading for Ghunsur and Kheriar cattle are in operation in the State of Orissa. They progress reports for the schemes have, however, not been received.

Central Artificial Insemination Station, Bangalore

The centre was established with the Jersey bulls received through the U. S. T. C. M. in India. The centre is primarily intended for the production and distribution of Jersey semen to places where cross-breeding schemes are in operation in the various States. In view of the serious shortage of bulls of breeds of all-India importance with home tracts in Pakistan, the station also maintains breeding bulls of Sahiwal, Sindhi and Tharparkar breeds. During the year under report, 15,227 cc. of diluted semen was despatched to the different States. The consignment comprised 11,422 cc. of Jersey, 3,745 cc. of Sindhi and 60 cc. of Tharparkar semen. Out of these, 2,772 inseminations comprising 2,544 Jersey, 209 Sindhi and 19 Tharparkar were successfully carried out in the States of Kerala, Andhra, Madras, Madhya Pradesh and Mysore. During the year under report, three different types of semen shippers were tried for their suitability: (a) imported Danish Sperma container, (b) I.V.R.I. shippers, and (c) shipper designed by Southern Regional Station of N.D.R.I., Bangalore. Of these, the Danish type and the one designed at N.D.R.I. were found suitable for air transport. The latter was more suited as it could carry larger quantities of semen. Observations on the various dilutions revealed that 1/20 dilution gave optimum results.

On an average 4 cc. of semen was obtained per collection from each bull.

Cross-breeding schemes

The question of increasing milk production of nondescript cattle found in hilly areas and areas of heavy rainfall and the adoption of a suitable breeding policy for these areas was discussed at a meeting of the Animal Husbandry Wing, in 1953, at Poona. In view of the empirical evidence provided by casual observations in regard to the superiority of the existing cross-bred animals in the areas, the Wing decided that the breeding policy in the case of nondescript cattle population in these areas should be revised and cross-breeding introduced if a planned scientific investigation warranted such a revision. Accordingly, the I.C.A.R. sanctioned a co-ordinated cross-breeding scheme with 10 units in different parts of the country.

The main objective of these schemes is to investigate the potentialities of cross-breeding of nondescript cattle for increased milk production, and to examine the extent of and conditions for increasing the milk production and the optimum proportion of foreign blood which would enable these animals to do their best. The foreign breed being used is Jersey.

Realising that if cross-breeding is found to be the best solution for improving cattle in the hilly and heavy-rainfall areas in India, it will not be possible to import thousands of foreign bulls that would be required for the purpose, it has been decided that breeding should be done through artificial inseminations only, in the investigation. Accordingly, a Central Artificial Insemination Centre has been established at Bangalore where Jersey bulls are stationed. Semen is sent from this station by air to the various units and investigations are going on to find out the effects of storage, packing and transportation of semen on its motility and other keeping qualities.

Broadly, every unit consists of one main and four sub-centres each with a population of about 500 nondescript adult cows. In each unit, proper data pertaining to breeding, feeding, milk production, etc. are being maintained, together with other relevant information which is required for evaluation of the results and for the formulation of a breeding policy for these areas. Systematic records of the quality of semen at the time of despatch, duration of transit and the quality on receipt at destination and of the time of actual utilisation are also maintained.

During the year, a meeting of the Officers-in-charge of the Cross-breeding Scheme was held at Ootacammund, mainly with the object of expounding the scheme to them and to develop in them a common outlook and approach so that the data obtained under the scheme may be of comparable nature. At this meeting, all items of technical programme were discussed in detail and suitable suggestions to improve the working of the schemes were made. Stress was laid on the need for intensifying the propaganda with regard to the scheme. As a step towards this, it was decided that a sum of 4 annas should be paid to the graziers for bringing cows-in-heat for insemination to the Centre. In addition it was decided that suitable medicines be provided at each centre for the treatment of sterility and other common ailments, and that calf rallies and cattle shows be organised for the purpose of educative propaganda. Various other recommendations pertaining to the scheme were made and sent to the State Governments for necessary action.

The work done during the year in the various units is described below:

Andhra Pradesh—Vishakapatnam

The scheme at this centre came into operation from July, 1955. The main centre for the scheme is located at Vishakapatnam. The preliminary house-to-house survey of the various centres selected for the scheme was conducted and information with regard to population, breeding practices, milk production, availability of feeds and fodder, feeding practices, utilization of milk etc., was obtained. Essential items of equipment (except tattooing sets) were obtained. Along with the survey work, propaganda with regard to the scheme was also done in the villages.

No separate building for the main centre, which is located in the Veterinary Hospital, Vishakapatnam, could be provided. The present accommodation is not considered suitable, and the State Government has been asked to make arrangements for alternative accommodation. Rented buildings for the sub-centres have been taken.

Annual insemination work started in December, 1955, and continued up to March, 1956 ; 52 consignments of semen were received from Bangalore and 214 cows were inseminated.

Marking of animals could not be done as envisaged in the technical programme because of want of tattooing sets, which could not be provided. Milk recording was also taken up and during the period under review, 612 cows were recorded.

Assam—Shillong

The scheme at this centre started in December, 1955. The main centre of the scheme is located in Shillong and the sub-centres at Barapani, Laitlyngokt, Umsov and Nayabanglow. House-to-house survey of the centres selected has been completed and information on the various points obtained. Insemination work could not be started as most of the items of equipment had not been purchased. The Livestock Improvement Act has not been enforced and generally the progress of the scheme was slow. Efforts to intensify the work on all items envisaged under the technical programme are being made.

Bihar—Ranchi

This scheme started functioning in April, 1955. The main centre for this scheme is located at Ranchi in a rented building. The sub-centres at two places are located in veterinary dispensaries. The housing arrangements of other two sub-centres are not satisfactory, as suitable houses are not available on rent. House-to-house survey of the area has been completed and the necessary data with regard to population, milk production, feeding practices, utilisation of milk, etc., obtained. The area for the location of the scheme has not been found very satisfactory, but the centre is being retained because, firstly there is no better area available in Bihar and secondly, it is necessary to study the effect of various kinds of transport on the keeping quality of semen. There are certain difficulties in the transportation of semen to Ranchi because there is no aerodrome here. Semen has to be transported by air up to Calcutta and from there by rail to Ranchi. During the period under review, 69 inseminations were performed and out of the animals inseminated, 57 were subsequently examined for pregnancy. Milk recording of cows in the area of the scheme was started and some animals were marked for identification. A number of service crates have been erected at suitable places for insemination of cows. The Livestock Improvement Act has not been enforced in this area.

Kerala—Chalakodi

This scheme started functioning in April, 1955, the main centre having been set up at Chalakodi. Like other centres, preliminary house-to-house survey was completed and necessary data obtained. Laboratory equipment for the main centre and sub-centres was also

obtained. The tattooing sets for all the centres could not be provided, with the result that all the animals inseminated and milk-recorded could not be marked for identification. During the period under report, 2,085 cc. of semen was received and 740 inseminations were performed. One hundred and sixty-six inseminations were followed up for pregnancy diagnosis, out of which 70 were found to be positive. A large number of service crates were constructed at various places for insemination of cows.

Madras—Ootacammund

This was the first unit established under the co-ordinated cross-breeding scheme. The main centre is at Ootacammund and the sub-centres are located in the hilly areas round about Ootacammund. The main centre has been located in a rented building, while suitable buildings for the sub-centres have been mostly provided by the local people. This area appears to be very suitable for cross-breeding. For a long time, foreign bulls were being used in Ootacammund and people are now conscious of the advantages of the cross-breeding. All essential items of equipment required for the centres have been obtained. Semen is being supplied by air to Coimbatore from where it is despatched by road to Ootacammund. During the year, a large number of animals was marked for identification. From 4,060 cc. of semen received, 774 cows were inseminated. Systematic milk recording was started in the main and sub-centres and in all about 1,100 cows were milk-recorded. Intensive propaganda for the scheme was undertaken in the various centres.

West Bengal—Darjeeling

The unit started functioning only in January, 1956, and during a two-month period, preliminary steps were taken for the selection of site for the scheme, conducting of survey and for obtaining equipment.

Physiological genetics of different breeds of Indian cattle under adverse climatic conditions: The scheme was started in October, 1954 at the Haringhata Farm with a view to find out how the animals of Hariana, Gir, Tharparkar and Sindhi breeds would thrive when transferred from their home tracts to the hot and humid climate of West Bengal. Observations on body-temperature, pulse rate, respiration, haemoglobin percentage, cell volume, R.B.C. count and W.B.C. count were recorded. Study of the data collected so far revealed that there was very little variation in the body-temperature of the different breeds. The pulse rate of the animals varied according to the atmospheric temperature, being highest in September and lowest in December. Similar variation was observed in the rate of respiration also. A difference in haemoglobin percentage was observed from breed to breed, the maximum being in Sindhi and the minimum in Sahiwal. The lowest haemoglobin values were observed in the month of September and the highest in the month of February. There appeared to be some correlation between haemoglobin percentage and the rate of respiration. It was observed

that R.B.C. count was maximum in Sindhi and minimum in Sahiwal. There was no marked variation during different months, though the count appeared to be slightly higher during winter. The observations were based on preliminary studies. Further data were being collected.

Studies on immuno-genetics of cattle—I.V.R.I.

The work on the scheme commenced during the year 1955 at the Indian Veterinary Research Institute, with a view to study the breed differences amongst important breeds of cattle. The inheritance of cellular antigen and the effects of incompatible blood groups on the health of off-spring were also included in the programme. During the year under report, 8 Hariana cows were immunised with citrated whole-blood from their respective daughters. Out of these, 4 cows responded well and produced satisfactory quantities of antibodies in their sera after 4 or 5 injections at weekly intervals. The animals which did not respond were excluded from the experiment.

Iso-immune sera were collected from the 4 immunised animals and after absorption the anti-sera were fractionated to prepare 9 reagents, each capable of reacting with a unit of antigen. The reagents were used for detecting the presence of 9 antigenic factors arbitrarily designated as A, B, C, D, E, F, G, H and X. The reagents were preserved in the freezing chamber in the refrigerator.

Effects of hormones in relation to induced lactation, Mathura, U.P.

The scheme came into operation during October, 1955, at the Uttar Pradesh College of Veterinary Science and Animal Husbandry, Mathura. The objects of the scheme are :

(a) to induce lactation in uneconomic cattle through hormones ; and

(b) to determine the doses of hormones which will induce lactation and make the animals sterile.

The scheme also aims at investigating the possibilities of inducing sterility in breeding cows by the introduction of a spring into the cervix.

During the year under report, two cows were treated with implantation of one gram of stilboestrol subcutaneously in the rear region. The treatment did not result in the development of the udder. The animals were later treated with 500 mg. stilboestrol implanted in the same manner in the form of two tablets of 250 mg. each. There was slight development of the udder in one of the two animals ; this cow gave milk up to a maximum of 13 oz. in a day. The animal was still in milk at the time of reporting the results.

Another group of two sterile cows was also treated with 500 mg. of stilboestrol. One animal showed considerable development of udder, and flow of milk started in about 11 days after implantation. A peak yield of 30 oz. in a day was achieved. The animal was in milk at the end of the year under report. The second cow, however, did not show any development of the udder and did not come into milk at all.

A third group of two cows was treated with implantation of two grams of progesterone and 30 mg. of stilboestrol in the form of tablets. The animals did not show any udder development and there was no initiation of lactation. One gram of stilboestrol (two tablets of 500 mg. each) was implanted in a sterile Prejian Coro. There was marked udder development and lactation commenced 20 days after implantation. After 42 days the tablet was withdrawn ; there was further increment in yield. The peak yield of 8 lb. was reached after three months. The cow was in milk at the time of reporting the results. It appeared that the treatment was successful only in high-yielding animals.

During the year under report cervical springs of the type used in inducing sterility by Roy and Rowson were introdueed in two breeding cows during heat period. Subsequently the animals were inseminated whenever they came into heat. The pregnancy diagnosis made at regular intervals gave negative results. One of these, however, suffered from Johne's disease and died.

In order to have a preliminary idea of the changes that may be brought about in the body metabolism due to the implantation of hormones, bio-chemical studies were carried out on blood samples collected at weekly intervals. The hormone treatment had no effect on blood sugar, lipoid, cholesterol, total phosphorus constituents, W.B.C., R.B.C. and cell volume of the blood. The non-protein nitrogen contents in the case of the treated animals were found to be higher than that of the control group. There appeared to be a fall in calcium value during the post-implantation period. The phosphate activity and inorganic phosphoric constituents increased as a result of the treatment.

Observations made on the treated animals revealed that the implantation of stilboestrol brought about restlessness and sexual excitement but did not lead to pronounced nymphomaniac tendency. The cows treated with progesterone and stilboestrol did not exhibit any sexual excitement. The work under the scheme is being continued.

Co-ordinated cattle sterility scheme

The Council has financed a co-ordinated scheme on cattle sterility with the object of improving testing facilities in the subject of obstetrics and gynaecology at the various veterinary colleges and conducting investigations on problems relating to the subject. Regional sterility stations have been established in the States of Bihar, Bombay, Madras, Punjab, Uttar Pradesh and West Bengal. A Central Sterility Centre has been established at the Indian Veterinary Research Institute, Izatnagar.

Regional centres are established at various veterinary colleges, and the regional officers who have received specialised training in the subject are imparting training to final year students in the subject of veterinary obstetrics and gynaecology. The investigational work was being taken up at the various Government farms. and other organised institutions. During the year under report, cattle of Hariana, Tharparkar, Sahiwal, Sindhi, Kangayam, Halika Gir, and Nimar breeds, nondescript and graded stock were under

investigation. Murrah, Surti nondescript and graded buffaloes were also taken up for investigations. The results obtained at the various centres will be reported next year.

Sheep Breeding

The co-ordinated scheme for the improvement of sheep and wool production on regional basis through research carried out at a number of centres located in different regions of the country according to a planned programme was continued. The work carried out at the different centres is summarised below.

Andhra Pradesh—Vishakapatnam

Experimental breeding of sheep to evolve superior strains is undertaken in this region by cross-breeding the local sheep with the Rambouillet (Merino) rams.

Uttar Pradesh—Pipalkoti

This is one of the research centres in this region. As the farm-born Rambouillet rams had not attained maturity, the entire flock of pure-bred ewes, F_1 cross-breed ewes, and Rampur, Bushiar ewes was divided into two groups and allotted to the imported Rambouillet rams. Out of 12 Rambouillet, three F_1 cross-bred, and 120 Rampur-Bushiar ewes mated during the year, 10, 2 and 92 lambs were born. The average birth weights of these were recorded as 5·2 and 4·9 lb. for F_2 C.B. Rambouillet rams and ewes, and 8·0 and 9.0 lb., for F_2 C. B. Rambouillet males and females respectively. The corresponding birth weights for the pure-bred Rambouillet lambs worked out to 8·5 lb. for both the males and females. The records of body weights, length, height and girth were being maintained for each group for each quarter of the year.

The Rambouillet flock was shorn once a year whereas the cross-bred and the Rampur-Bushiar sheep were shorn twice a year. The annual average fleece yield for Rampur-Bushiar ewes, cross-bred F_1 ewes and Rambouillet ewes was recorded as 2 lb. 11 oz., 4 lb. 13 oz. and 6 lb. 11 oz. respectively. The samples were sent to the laboratory and the results are awaited.

The practice of shifting the Rampur-Bushiar stock and the cross-bred progeny to the mountain-top pastures was continued. Rambouillet stock was maintained at the farm. Concentrate feed supplement was given to the Rambouillet sheep, cross-bred flock and out-of-condition Rampur-Bushiar ewes. During the winter drought, the flocks were occasionally given concentrate supplement.

The flock maintained good health during the year and the percentage of mortality was 10 per cent as compared with 15·5 per cent for the previous year. There were no deaths amongst the Rambouillet and cross-bred adult flocks. The dipping of flocks in 2 per cent Gammexane after shearing and de-worming with phenothiozine at monthly intervals during the rainy season and two-month intervals during the rest of the year was continued.

Wool Laboratory

During the year under report, in all, 879 samples were handled by the laboratory. A study of the wool samples from the Rampur-Bushiar and F_1 crosses revealed that there was considerable improvement in the quality of wool of the cross-bred progeny. The percentage of medullation was reduced from 52·67 to 4 per cent; the average length of fibre increased from 39·8 to 71·58 mm.; and the average diameter decreased from 38·2 to 24·84 microns. The comparative study of wool samples from Pipalkoti, Pashulok and Gwaldan indicated that the Rambouillet cross-breeding with the Rampur-Bushiar ewes was yielding indentical results. The wool from the Rambouillet crosses was consistently superior to the Polwarth crosses as regards the medullation and fineness.

Regional sheep breeding scheme, Kashmir: This is the second centre in the region established with the object of evolving superior wool by crossing the indigenous types with the imported Rambouillet rams.

During the year under report, 243 ewes from the foundation stock were mated to 4 farm-born Rambouillet rams. In all, 98 lambs were born; the lambing percentage was 40. A study of the best season for mating indicated that the maximum fertility was achieved from matings during September and October at Banihal. The birth weight records of lambs showed that the largest number of lambs were born in 6 lb. and 7 lb. body-weight groups which accounted for 76 per cent of the total births. A study of the data on body measurement, *i.e.* length, height, girth, and average body-weight indicated that the length and height of the half-bred progeny was not significantly greater than that of the local sheep. The girth and body-weight were significantly higher in the cross-bred progeny.

During the year under report, 52 Rambouillet half-bred ewes were mated to the pure-bred Rambouillet rams and 36 lambs were born, giving a lambing percentage of 61. The growth records of the F_2 progeny will be reported next year. A study of the data on the fleece analysis indicated that the quality and quantity of wool obtained from the Rambouillet half-bred progeny at 1½ years of age was superior in all aspects when compared with the wool obtained from an identical flock of the local ewes.

During the year, 39 rams were issued for up-grading the village flocks. Since the inception of the scheme in all 227 cross-bred rams have been issued for this work. The study of the data on comparative advantage of shearing twice a year, as against one shearing a year, indicated that two shearings in a year gave better results. The problem will be further investigated when more sheep are available amongst cross-bred flocks.

During the year under report, 12,425 cases, including those of systematic disease, were treated in the various flocks. To safeguard the flocks against common contagious and parasitic diseases, 2,752 vaccipations, 1,969 inoculations, 4,187 dosings and drenchings and 795 dippings were carried out.

Himachal Pradesh—Sarhan: This is the third centre in the Himalayan Region. The scheme started functioning from the 1st October, 1955. The work pertaining to a few months has been reported. The farm had been established and preliminary arrangements for the construction of various buildings were completed. A foundation flock of 185 indigenous ewes for selective breeding and cross-breeding work had been obtained.

Southern Region

The main centre of this region is situated at Poona (Bombay). The object of the scheme is to evolve new strains of sheep carrying superior fleeces suited to conditions in the Deccan plateau and to maintain data relating to wool quality inherited in successive generations of experimental breeding of sheep. The scheme also involved the supply of breeding stock to the rural areas and study of the important problems of sheep husbandry, including nutrition. The programme includes the selective breeding of the Deccani sheep and cross-breeding these to the Merino and Rambouillet rams and further inter-breeding the different grades.

Poona—Selective breeding: During the year under report, 47 Decanni ewes were mated to two selected rams; 35 lambs were born—of which one died before the age of one month. A study of the percentage of medullated fibres of rams and progeny indicated that no significant improvement was caused in the progeny of rams under trial. The diameter of the fleeces of the rams and their progeny was of the same order. There was no increase in the fleece density of the progeny. However, the wool quality of the progeny of ram No. 377 appeared to be superior to that of the progeny of ram No. 368.

Cross breeding: During the year under report, 43 ewes of different strains of Merino were mated to the Merino ram. The fleeces of the F_1 Deccani Merino crosses were analysed and the fibre diameter of the progeny was 28 microns as compared to 36 microns of the dams. The percentage of medullated fibres was reduced to 10 per cent as compared to 21 per cent in the rams. The average annual wool yield was recorded as 42 oz. as compared to 21 oz. for Deccani sheep. In the case of 3/4 Merino bred flock, the wool yield was 44 oz. for the F_1 generation animals. It was observed that on the whole the progeny born of F_1 C. B. ewes crossed with Merino rams had superior and heavier fleeces. A further improvement in quality and quantity of fleece was observed in the 7/8 Merino bred flock. It was thus observed that forward mating towards the Merino had resulted in improvement in the quality of wool in the progeny. Trials on inter-breeding amongst cross-bred strains revealed that through these matings, progeny with superior fleece were produced. The fleeces obtained from breeding of 1/4 bred ewes to 5/8 Merino bred-ram had a fibre diameter of 28 microns conforming to 58 spinning quality wool based on diameter of fibres.

Establishment of breeding lines with Rambouillet ram: During the year, 33 Deccani ewes were mated to the Rambouillet ram. The average fibre diameter of fleeces of the progeny was 29 microns as compared to 39 microns in the fleeces of their Deccani

rams. The fleece density had increased from 894 fibres to 1,379 fibres per sq. cm. in the progeny. The average fleece yield for F_1 cross-bred ewes was recorded as 55·7 oz., as compared with 21·3 oz., for pure-bred Deccani rams.

Trials with village flocks: As reported during last year, improved rams had been issued to 150 flocks. During the year under report, three flocks were selected to study the improvement brought about in the quality of wool of the progeny. The fibre diameter of the fleeces obtained from the progeny was 38 microns as compared to 39 micorns in the case of the dams. The average wool yield of the progeny was recorded as 11 oz., as compared to 9 oz. for the foundation flock.

Madras State—Nilgiri: This is the second centre in the Southern Region. The object of the scheme is to carry out selective breeding amongst Nilgiri ewes. Ten Romney Marsh rams were purchased for cross-breeding experiments. During the April-May breeding season, 97 ewes were mated, of which 65 lambed. The average fertility worked out to 67 per cent; three ewes gave birth to twins and there were three still-births during the season. Another 176 ewes were mated during the November-December mating season. The lambing has not completed as yet. The average wool yield for the different classes of animals was recorded as 1 lb. 4·9 oz. for rams and 1 lb. 3·2 oz. for ewes and 15·5 oz. for yearlings. The average wool yield for the entire flock work out to 1 lb., 2·5 oz. The highest yield recorded was 2·6 lb., for ewe No. 285.

During the year under report, the mortality amongst the adult stock was recorded as 3.47, per cent, as compared with 3·31 per cent in the previous year. The slight increase was due to the higher number of old ewes in the flock. The mortality in the young stock was 4·47 per cent as against 6·6 per cent for the previous year. Sixty per cent of deaths was due to weakness and debility.

Dry Northern Region

Rajasthan: This is the main centre in the Northern Region and the work at this centre envisages selective breeding of the Bikaneri sheep. During the year under report, a site near Sirdarshahar was selected for the establishment of the Sheep Breeding Farm. A survey of adjoining villages was carried out for the purpose of selecting flocks for extension work and for the purchase of foundation flocks; the scheme made no progress.

Bombay—Joria: This is the second centre in the sheep-raising area of the Northern Region. The scheme is working since December, 1953, as a part of the Regional Plan. The object of the scheme is to evolve a breed of sheep yielding non-hairy fleece with a uniform staple which could be utilised for the manufacture of clothing and high-grade carpets. The programme includes selective breeding of Patanwadi and Kutchi sheep.

During the year under report, 104 Patanwadi ewes were mated to 4 selected rams. The allotment of ewes was carried out on the basis of fineness of fleeces. During the year, 86 ewes were mated

to the 4 selected rams, and 70 conceived. In all, 73 lambs were born, out of which 37 were male and female. The over-all percentage of lambing worked out to 84·88. The sheep were shorn twice a year. The average clean wool yield was 18·56 oz. for the ewes and 19·11 oz. for ewe lambs. The yield for the rams was recorded as 47·59 oz., and the same for the ram lambs as 35·12 oz.

A study of the quality of wool of the progeny revealed that there was no appreciable change brought about in the quality of fleeces of the progeny over that of their rams. The average fibre diameter for the progeny was 29·75 $\pm$ 0·19 microns, as against 29·61 $\pm$ 0·31 microns for the rams. The results were based on comparisons of 65 pairs of rams and daughters. The percentage of medullated fibres was 15 $\pm$ 3·31 for the progeny as against 12 $\pm$ 1·28 for the rams. The slight increase, however, was not significant. When examined statistically the fleece density of the foundation stock varied from 449 to 1200 fibre per sq. c. m., with an average of 834 $\pm$ 23 fibres per sq. c. m. as against 504 to 1699 fibres per sq. c. m. with an average of 938 $\pm$ 27 fibres per sq. c. m. for the progeny. The increase in the fleece density of the progeny was found to be significant at 5 per cent level.

The average birth weights of ram lambs were recorded as 6·2 lb., and that of ewe lambs as 5·78 lb. The average growth of lambs up to the age of 24 weeks was 1·38 lb. per week while the same in the case of ewe lambs was 1·05 lb. per week. The ram lambs grew faster than the ewe lambs.

Under the programme of work of selective breeding of Kutchi-Marwari ewes, a foundation flock consisting of 15 ewes and 4 rams was purchased during the year. The actual work on breeding in this group will be undertaken during the next breeding season.

Eastern Region

Bihar—Gaya: The scheme started in October, 1953 with the object of testing the adaptability of the cross-bred sheep obtained from the Romney Marsh and Gaddi rams to the local climatic conditions. It was decided to up-grade the Chota Nagpuri sheep to the Romney Marsh and Gaddi rams. The work on grading up with the Gaddi rams is in progress. During the year, 86 Chota-Nagpuri ewes were divided into 4 groups and allotted to 4 selected Gaddi rams. Of these, 29 ewes could be mated, resulting in 24 lambings. The average birth weights of the lambs were recorded as 3 lb. 15 oz. for males and 4 lb. 4 oz. for females.

During the year, eight Rommey Marsh rams were imported from Australia for cross-breeding programme. For this purpose, an indigenous flock of 88 ewes was obtained and arranged into four groups. Work on this item is continuing.

Wool Analysis Laboratory—Gaya: During the year, 258 samples were analysed. Of the 174 samples analysed for medullation and diameter, 100 were from the local Shahabadi ewes and 50 collected from the F_1 progeny in the village flocks. The average medullation in the Shababadi ewes worked out to 46·0 per cent and

the same for the F_1 progeny came to 36·8 per cent. The average medullation for 24 samples obtained from Wool Department Centre at Santhal Pargana worked out to 43·8 per cent. Due to wide variations in fibre diameter and high percentage of kemp in all the samples, no definite rule could be followed for the classification of wool in the area. The fleeces had, therefore, to be graded on the basis of kemp percentage and colour.

Sheep Research Station, Hissar—Punjab

The centre was established in 1953, with the object of improvement of the Bikaneri sheep and their wools under range conditions, conducting fundamental research and standardising methods for the measurement of various characters of wool. As reported in the previous year the flocks were maintained in two groups, A and B, according to their wool quality. However, during the year it was not possible to maintain the previous family lines due to the reconstitution of new groups for the plan to carry out heritability estimates. The flock, however, has been kept closed to outside blood since the year 1937. The mating season continued from March to May, 1955 and lambing commenced from the last week of July and continued to the end of October. The fertility of the flocks in terms of number of ewes put to the rams and number conceived was 76·4 per cent in flock A and 69·0 per cent in flock B. The fleeces from 169 females were put to Benzol test. It was observed that 68·5 per cent came under group A with an approximate medullation of 0 to 20 per cent. Another 23·9 per cent were classified under group B with a medullation of 20 to 40 per cent and 7·6 per cent were in group C with 40 to 60 per cent medullation. Of the 152 males 65.8 per cent were in group A, 21·4 per cent in group B and 12·4 per cent in group C. During the investigation on estimation of clean fleece weights, it was observed that the assessment of clean fleece yield for any sheep in conducting heritability trials could be made on the basis of obtainig one sample from the shoulder region. Analysis of the data on fleece covering scores indicated that the assessment of fleece covering scores was a reliable method of measurement and the character persisted in subsequent assessments. A low correlation between body-scores, body-weight and body measurement was observed. The results of the analysis of data on 15 yearling ewes indicated that it was not possible to assess medullation in fleece on the basis of one regional sample.

A study of the effect of washing and dipping on fleece quality indicated that (a) washing had no effect on fibre length, fibre thickness and medullation in the fleece but it decreased the tensile strength of the fibre ; the general look of the wool was bright but unattractive harsh and brittle ; (b) that dipping had no effect on fibre thickness, medullation and tensile strength of the fleece but helped in the significant growth of the fibre. The wool was tinged yellow and adverse effects as observed in washing were also apparent to a certain extent.

Post-graduate course in sheep and wool—Hissar

In all, 8 students from different states completed their course of training in sheep husbandry and wool production, during the year; 5 new students were admitted to the third batch.

Goat Breeding

Angora Goat Breeding Scheme—Uttar Pradesh

The scheme was started in the year, 1955, with the object of evolving mohair-yielding strains of goat by crossing the white-haired local goats with improved Angora bucks. In March, 1955, the herd was shifted to Gwaldam (Garhwal), as there was a shortage of grazing at Pipalkoti.

The climatic conditions were more conducive to the health of the stock from April to June, but from June to September there was excessive humidity.

The herd was reorganised into three groups, namely, the farm-bred graded does, Hissar-bred graded does and Himalayan white long-haired does. Each group was allotted to a pure-bred Angora buck. During the period under report, 35 kids were born, out of which 15 were male and 20 female. Almost all the kids except 4 were dropped during the month of March. The average body-weight of kids at birth were recorded as 4·9, 5·0 5·5, and 5·0 lb. for F_1, F_2, F_3, F_4 graded male progeny respectively; the birth weights in the graded female progeny were recorded as 4·9, 3·9, 4·4, and 4·5 lbs., respectively, for the different groups.

Shearing was done twice a year and the average annual fleece yield was recorded as 302 oz. for pure-bred Angora bucks and 174 oz. for first-cross goats. There was considerable improvement in fleece yield in the second and third crosses as compared with the first cross. The average annual yield for second cross was recorded as 333 oz. and for third cross as 429 oz. The fleeces were taken over by the Department of Cottage Industries.

The herd was dipped after each shearing in 2 per cent Gammexane suspension to free the animals from ecto-parasites. The dipping had no adverse effect on the quality of mohair for industrial purposes. Washing of goats prior to shearing was given up, as it removed the grease and reduced the spinning quality of the fleece.

No outbreaks of common contagious diseases were encountered during the year. Regular de-worming of the stock was carried out at monthly intervals during the period July to September and once in two months during the rest of the year. There were altogether 11 deaths, of which 10 were among the adults and one among the kids.

Development of mutton breeds of goats—West Bengal

The scheme started in August 1955 at the Central Livestock-*cum*-Breeding Station, Haringhata. The object of the scheme is to improve the size of Black Bengal goats by selective breeding and grading up without adversely affecting the desirable qualities like early maturity, prolificacy, and fine skin, as found in the Black Bengal types. Barbari goats have been selected for up-grading programme.

Sixty-four nannies and 4 bucks of Black Bengal type were selected from the existing Haringhata stock from the earlier scheme of

the Council. Two nannies with two kids and two bucks of Barbari breed were purchased from Uttar Pradesh for the up-grading programme. The herd was divided into 8 groups and 21 nannies from these groups were mated with the selected bucks. During the short period under report there were only 5 kiddings, of which two were twins, two were triplets and one was quadruplet. The average birth-weight of kids in the case of twins was 1·89 lb. for males and 1·81 lb. for females. The corresponding birth weights for triplets were 1·65 lb. and 1·73 lb. respectively. The average measurement of body characters like length, height, girth and live-weight were recorded for the foundation stock.

Poultry Breeding

Poultry development—Travancore-Cochin (Kerala)

The scheme was started in 1952 to investigate the suitability of the exotic breeds of fowls, the White Leghorn and the Rhode Island Red, in heavy rainfall and humid climate and to up-grade *desi* fowls.

The study of seasonal variation on fertility and hatchability showed that seasons did not have much influence on the fertility or the hatchability percentage. However, age seemed to have an effect on both, as higher rate of fertility and hatchability was obtained from eggs laid by younger birds than those of the higher age-group; it was also observed that shark-liver oil when added to the ration brought about a steady increase in both, among the birds of all age-groups. Growth-rate studies revealed that chicks of Rhode Island Red were smaller than White Leghorns at hatch and attained more weight only after 8 weeks. The average age at maturity as assessed by the first egg laid worked out to 161·46 days for White Leghorn and 194·7 days for Rhode Island Red.

It was also observed that pullets acquired early maturity in later generations due to the progenies getting adapted to the prevailing climatic conditions. The average annual production was recorded as 189 eggs for White Leghorn and 176 eggs for Rhode Island Red. The average egg-weight was found to be 2 oz. 0·9 dr. for White Leghorn and 1 oz. 13·8 dr. for Rhode Island Red.

The up-grading of *desi* fowls in villages was also undertaken. A number of surplus cocks were distributed in selected areas. Systematic study and follow-up work on graded progenies will be taken up after the studies on White Leghorn and Rhode Island Red have been completed.

Commercial chick hatchery and poultry-processing

The scheme commenced from the 1st June, 1955, at the Agricultural Institute, Katpadi. Its object was to investigate the possibilities of establishing a commercial hatchery and processing plant under local conditions. During the year under report, out of 15,032 eggs purchased, 15,028 were actually set in the incubators, from which 7,336 chicks were hatched out, giving a ratio of 49 per cent to the total number of eggs set; 950 chicks were imported from the United

Kingdom, making a total of 8,296 chicks ; 697 chicks were sold to the 7 units established within a radius of 10 miles from the farm.

There was a heavy mortality among the chicks due to the outbreaks of Ranikhet disease and coryza. The former was effectively controlled by regular vaccinations of 8-week old chicks, the latter through intramuscular injections of Dihydro and streptomycin. Coccidiosis was kept under control by dosing affected birds for three consecutive days with 'embazin' mixed at the rate of 2 oz. in 3 gallons of drinking water. Gammexane was periodically used to avoid parasitic infections.

Influence of climate on the performance of desi *fowls—Orissa*

The scheme was started in January, 1953 with a view to study, under diverse conditions of soil and climate, the performance of improved strains of *desi* fowls developed by the Indian Veterinary Research Institute. Attention was focussed on the study of economic characters like growth rate, egg production, sexual maturity, persistency of production, hatchability etc.

Persistency in production was studied from the 1953-54 records of 25 birds and it revealed that birds with higher persistency records had better annual egg-production average. This, however, needs statistical interpretation. Production figures of only 32 birds were considered, which gave the annual average production of 26 eggs per bird with a range of 46 to 219 eggs. The maximum egg production was obtained in December and the period from November to March appeared to be favourable for high egg production. A study of the dam-daughter comparison revealed that there was no decline in the production of daughters as compared with their dams.

Complete records of pullets from hatches of 1954-55 were not available, but on the data collected so far, an average production of 98 eggs per bird and average weight of 1·6 oz. per egg was recorded.

A study of relationship between sexual maturity and egg production revealed that birds maturing earlier had a better average production. A similar conclusion was drawn from the data of 1954-55. Investigations on the relationship between phenotypical characters and physiological characters could not be concluded. Higher moulting incidence was observed during the month of May and most of the birds continued to lay even while moulting. Feed consumed by 100 chicks from birth to 24 weeks of age was 1707·7 lb.

Studies on the fertility and hatchability did not bear encouraging results. Growth-rate records of chicks were maintained from birth to 24 weeks of age at successive intervals of 8 weeks. Incidence of diseases and mortality was also recorded. Losses were mostly due to ravages of predatory animals. Birds were periodically treated for helminthic infections and were protected against Ranikhet disease and fowl-pox.

Egg-laying trials, I.V.R.I., Izatnagar

The scheme was put in operation from 1st October, 1955 at the Indian Veterinary Research Institute, Izatnagar, with the object of

helping poultry breeders in building up flocks of high-laying birds and to improve upon the prevailing marketing practices. Pens of 5 birds each were received from different breeders participating in the trial. The birds were protected against Ranikhet Disease and fowl-pox and were housed, fed and managed under standard conditions. Accurate records in respect of the number of eggs produced, size, egg quality, feed consumed and other particulars were maintained separately for each bird to work out the economics of egg production. During the experimental period of six months the maximum number of eggs laid was 114 per bird and the average weight per dozen eggs worked out to about 24 oz.

Duck breeding scheme—Kerala

The scheme was started on the 16th November, 1954, with a view to study the economic qualities of Indian Runner and Khaki Campbell ducks when reared under ideal conditions of housing, feeding and management, to establish suitable strains for upgrading local ducks and to conduct studies on incubation, rearing, nutrition, diseases and other problems of duck industry. The start of the experiment was delayed owing to the non-availability of good strains of Runners and the late arrival of the consignment of the two strains of Khaki Campbells from Haringhata and the Indian Veterinary Research Institute. Meanwhile, a survey was conducted which revealed that keel disease of ducklings was prevalent and that it accounted for 50 per cent of mortality in certain cases. However, laboratory findings were lacking. The results of various studies on the flock will be reported next year.

Duck breeding scheme, I.V.R.I., Izatnagar

The scheme started functioning from December, 1955 with the main object of exploring the possibilities of rearing and breeding pure breed of Khaki Campbell ducks without elaborate arrangements of water tanks, etc. Twnety hundred and seven day old ducklings were received from United Kingdom, which suffered heavy mortality due to an obscure viral disease.

Investigations were taken up immediately in respect of the aetiology, symptoms and course of the disease, but by the time the mortality could be controlled only 62 ducks and 50 drakes were left. Out of these, 31 females and 25 males were transferred to the Duck Breeding Scheme, Travancore-Cochin State. Records of food consumed, growth rate, mortality and egg production are being maintained.

Animal Nutrition

Trace-element scheme—I.V.R.I., Izatnagar

The scheme to study the influence of trace-elements on the health and productive capacity of livestock in India continued to function at the Indian Veterinary Research Institute. The scheme was initiated in the year 1952, with the object of finding out whether trace-element deficiencies occur in livestock in India and if so, where.

During this year, 137 feed samples were analysed for their copper content. In dry roughages like hays and straw the content of copper ranged from 1·67 parts per million (p.p.m.) in paddy straw to 8·69 in hays. Eighty per cent of the samples had values below 5 p.p.m. Legumes like *Metha,* cowpea, *Berseem* and lucerne exhibited a range of 7·13 to 15·88 p.p.m. on dry matter basis. Oil-seeds and cakes had in general high values ranging from 12·13 p.p.m. in cotton-seed to 20·4 p.p.m. in cotton-seed cake. Bran, *Chunni,* etc., had values ranging from 5·80 p.p.m to 14·20 p.p.m. On the other hand, gram husk had comparatively much poorer content, the range being between 1·33 to 6·90 p.p.m. The copper intake per day in milligram for cattle weighing 800 lb., in different farms was also calculated. It was observed that intake according to the requirements was definitely sub-normal in Udaipur, Nagpur, Pudukottai, Tejur and Almora. The haemoglobin content of animals in all these places was sub-normal.

Studies were continued on the manganese content of feeds in Rajasthan, Madhya Pradesh, Madras, Mysore, Bombay and Uttar Pradesh. Samples from Jodhpur had a value of only 16·5 p.p.m. of manganese on dry matter basis, whereas hay from Tejur had a value of 234 p.p.m. Paddy straws were found to contain very high values ranging from 265·7 p.p.m. at Bankapur to 1365·5 p.p.m. at Tejur. Concentrates like grains, oil-seeds and oil-cakes had values ranging from 15·3 p.p.m. to 26·5 p.p.m. The approximate *per capita, per diem* ingestion was also studied; 540 mg. was found to be essential for a milch cow.

Cobalt content of feeds in the States of Punjab, Uttar Pradesh and West Bengal were ascertained. The daily requirement of non-producing cattle was worked out at 0·50 mg. per hundred pound body-weight. Studies on haemoglobin content of blood of animals at different farms were continued. The haemoglobin content of buffalo calves at Almora was found to be 11·5 mg. per hundred c.c. of blood, which is quite normal.

Liver samples collected from various slaughter-houses were examined for their copper content and the values revealed that goat liver from Nagpur and Udaipur localities had definitely sub-normal values. Thyroid glands of goat and sheep collected from hilly areas of Uttar Pradesh were found to be moderately enlarged and the histo-pathological examination showed changes associated with hyperplasia, seen in subclinical forms of parenchymatous types of goitre.

Regional animal nutrition centres

In pursuance of the Council's policy for regionalisation of animal nutrition research, a regional animal nutrition centre for the western region was opened at Anand in 1952, a southern regional centre at Bangalore in March, 1954 and an eastern regional centre at Haringhata in September, 1954, to study the problems of animal nutrition pertaining to each region.

Western Regional Station, Anand: As mentioned last year, work was continued at the Animal Nutrition Research Station, Anand. The centre was set up in February, 1952, to undertake the bulk of applied

work on animal nutrition in the region for improving both the quality and quantity of fodder with a view to improving the standard of animal nutrition and increasing production. The centre has been handling all the problems prevailing in the States of Bombay, Rajasthan, Punjab and parts of Madhya Pradesh and Uttar Pradesh and in the erstwhile States of Saurashtra, Kutch and Madyha Bharat.

Fodders and grasses from Hissar area were analysed and a survey of feeding practices and deficiency diseases prevailing in that area was carried out. The composition of grasses from sweet and saline regions of Banni area in Kutch and Kush (*Eragrastis cynosuroides*) grass from Rajasthan was studied. Digestibility trials on common concentrates and fodders were undertaken for comparing their nutritive values. Samples of blood of bullocks and buffaloes from slaughter houses, and of farm bullocks, were analysed to have a complete blood picture.

The survey of Hissar area covering four villages selected at random was carried out and samples of fodder were collected at different stages of growth. It was observed that crude protein either extract and calcium content decreased, while crude fibre and N.E.F., increased with maturity. The composition of grasses from the Hissar 'Bir' area indicated that Ghamur (*Panicum antidotale*) was superior, being richest in protein (10·42 per cent) and calcium (0·481), and comparatively low in crude fibre (33·54 per cent).

In the survey of feeding practices, it was observed that the common fodders fed to cattle were *Jowar, Bajri or* wheat chaff and green fodder available from pastures. *Guar* and grams were the concentrates in common use. The data collected brought out the fact that 90 per cent of the farmers were over-feeding their bullocks with respect to T.D.N. and 70 per cent with respect to digestible proteins. In the case of milch cattle also, overfeeding of total digestible proteins was observed in about 80 per cent of cases. This was attributed to the fact that the cattle owners did not change the ration of animals according to their work or milk produced. In the clinical examination of about 4,000 animals at Hissar, no symptoms of deficiency diseases were evident.

In the Banni area of Kutch, *Dabhado, Dinai, Khivai* and *Oin* were the predominant grasses. The results of analysis indicated that *Oin* was best amongst all the available grasses. It had 12 per cent protein and was found to be rich in minerals and low in crude fibre. The cattle owners, however, liked *Dinai* grass best. Under experiment it was found that the maximum digestible protein (22·23 per cent) was provided by *guar* seeds and the minimum (2·54 per cent) by *bajri* husk. The T.D.N. supply through maize bran was highest (88·42 per cent) while that by cotton-seed cake was lowest (57·70 per cent). Between the gotars supplied about 20 per cent more T.D.N. and six times more D.P. than *tur gotar.* Only *guar* seeds and *guar gotar* were found to give positive balances for nitrogen and both the minerals, while *bajri* husk recorded negative balances for all the three nutrients.

Extension work was carried out by disseminating useful information to the cultivators about feeding of cattle, while doing survey

work in villages. Social and Extension workers were drawn around the centre and given an idea about animal nutrition work for extension purposes.

Southern Regional Station, Bangalore : The scheme was started in the year 1954 at the N.D.R.I., Bangalore. During the year under report animal nutrition survey was carried out in Nagercoil area in Trivandrum district. Some of the natural grasses were collected from the grazing areas at monthly intervals in *Kharif* season. The cultivated grasses and fodders were also collected and analysed along with the locally available feeds and fodders. It was observed that protein and calcium requirements of cattle were not completely provided by the existing feeds and fodders.

Cattle did not get enough green fodder even during the monsoon period. General malnutrition, calcium and vitamin deficiency, late maturity, late calving and stunted growth were very common in the area. Night-blindness in cattle, death amongst calves after fits and tympanites were also very common.

Work on animal nutrition survey was also done in some of the districts of Madras State. Extension work was being done by disseminating information about nutrition of cattle while contacting the ryots and livestock owners in connection with animal nutrition survey work, and during cattle shows.

Eastern Regional Station—Haringhata (W. Bengal) : Preliminary survey was carried out in Haringhata and it was observed that the intake of digestible protein and starch equivalent was considerably below the accepted feeding standards. A number of fodder crops were analysed with a view to select better and high-yielding varieties. Intensive studies were made with *berseem* and it was found that protein, carotene and tocopherol contents were closely correlated with one another. A large number of fodder crops consisting of exotic, I.A.R.I., and indigenous grasses and legumes were analysed. Amongst the exotic grasses, *Panicum antidotale* was found to regnerate very quickly after each cut and was found to be very nutritious. Amongst leguminous crops, *Khessari* was found to be the best. Results of the survey indicated that goats in that region had a very low reserve of hepatic copper. The goats also appeared to have a low magnesium content in their blood serum.

Investigation into the causes of degeneration of cattle in humid climates were continued under the scheme initiated in February, 1954. The scheme is being run at the I.V.R.I. with field units at Calcutta and Hissar.

As reported last year, experiments were being conducted on 16 Hariana heifers of 6 to 9 months' age which were transferred to Calcutta from Hissar and another 16 Bengal heifers of the same age, obtained locally at Calcutta. The Hariana and Bengal heifers were divided into two groups of 8 each. One group of eight animals of both the breeds was fed on Punjab diet while the other group of

both the breeds was given the Bengal diet. In addition to these four groups at Calcutta, a fifth group of 8 Hariana heifers fed on Punjab diet was maintained at Hissar which served as a control group. The experimental observations were made all through the year at Calcutta and at Hissar. The average monthly rates of growth in lb. for Hariana heifers at Hissar and at Calcutta on Punjab and Bengal diets were found to be 16·2, 12·5 and 10·5 respectively. Similar figures for Bengal heifers on Punjab and Bengal diets were 11·3 and 10·4 respectively. No appreciable difference was observed in pulse rate and body temperature. The average dry matter consumption per 100 lb. live weight per day for Hariana heifers on Punjab and Bengal diets was 1·90 lb. and 1·88 lb. respectively. The consumption of water in kg. per day for Hariana heifers on Punjab and Bengal diets was 2·90 and 2·281. Similar figures for Bengal heifers were 2·09 and 2·35 respectively. Hariana heifers at Hissar showed higher haemoglobin values than either the Hariana heifers or the Bengal heifers at Calcutta. Hariana and Bengal heifers on Punjab diet at Calcutta showed higher values of haemoglobin level and R.B.C. count in the majority of cases than their counterparts on Bengal diet. Hariana heifers on both the diets often showed higher values of W.B.C. count than Hariana heifers at Hissar. Lowest values in W.B.C. count were recorded in Hariana heifers at Hissar. The value of protein, non-protein nitrogenous substances and calcium in blood serum were found to be highest in Hariana heifers at Hissar and lowest in Bengal heifers at Calcutta. Quarterly faecal examinations for worms revealed that Hariana heifers at Hissar were often free from worms, whereas in Calcutta, worms were detected in all the groups. Feeding stuffs were periodically examined and photographic records of animals were maintained this year also.

Utilisation of waste products as cattle feed, Orissa

The scheme for the utilisation of waste products as feed for cattle in Orissa was continued. It was initiated in December, 1954, with the object of studying the palatability, digestibility and physiological response of the animals fed on such waste products as were already examined and found suitable in respect of their nutritive value, etc. and to find out the economics of feeding such products.

A preliminary survey of the area in and around all the four centres, *viz.*, Gudabhaga, Boudh, Keonjhar and Gasmundi was made and the availability of waste products, etc., was ascertained. It is proposed to take up experimental work on growing animals between the ages of 6 to 9 months, using tamarind seed and *Mohua* flowers.

Physiological norms of Indian cattle with special reference to West Bengal, Calcutta

The scheme for the investigation of physiological and biochemical, norms of Indian cattle with special reference to villages of West Bengal continued to function at the Bengal Veterinary College, Calcutta. During the period under report, analysis of blood with respect to sugar, calcium, magnesium and inorganic phosphorus was

done. Determination of the packed cell volume, plasma volume, total and differential count of leucocytes, total R.B.C. count, size of R.B.C. and haemoglobin estimations were completed.

Disease Control

Schemes for the investigation of diseases of cattle, sheep, goats and poultry continued to function in the States and at the Indian Veterinary Research Institute. Most of these schemes on cattle, sheep and goats and all the schemes on poultry have been taken over by the respective State Governments, but their progress reports and technical programmes are scrutinised and co-ordinated by the Council as before.

Mastitis

The co-ordination scheme for the investigation of bovine mastitis continued to function in Bombay, Uttar Pradesh, Madras and at the Indian Veterinary Research Institute. The scheme in Mysore and Punjab had terminated in 1955 and final reports are awaited. The object of this scheme is to determine by suitable diagnostic methods the extent of the prevalence of the disease, to find out the relative importance of different organisms involved in causing the disease, and to assess the efficacy of the various chemotherapeutic agents.

In Bombay, a systematic survey was undertaken in different private and Government dairy farms in the districts of Thana, Belgaum, Poona and in Bombay city and suburbs. Detailed bacteriological tests were carried out on the specimens collected from Veterinary Hospital, Parel and the samples received from different veterinary hospitals in the State of Bombay. In all, 828 milk samples were collected for examination. Out of 451 animals, 64 (19 buffaloes, 42 cows and 3 goats) were found to be affected with mastitis. Of these 21 were clinical cases and 43 latent cases of mastitis. In the majority of the cases, *Staphylococcus aureus, Streptococcus agalactiae* and *Streptococcus dysgalactiae* were the principal organisms detected. Different chemotherapeutic agents were tried with varying results.

At the Indian Veterinary Research Institute, experiments were undertaken to judge the efficacy of the indirect test in comparison to that of cultural examination for diagnosing mastitis. The percentage of accuracy was 72·1 with physical examination of udder, 68·4 with stripcup test, 72·1 with plate whiteside test, 74·3 with simplified chloride test, 67·6 with Hotis test, 85·3 with leucocytic count test, 74·3 with microscopical examination of the gravity cream, 50·7 with microscopic examination of fresh milk, and 67·0 with catolax test. Incidence of mastitis was studied in three different diary and cattle breeding farms at Karnal, Kirkee, and Pimpri. At Karnal, 425 milk samples from 120 cows were subjected to bacteriological examination, and 44 cows were found infected. The principal causative organism was *Staph. aureus* which alone was responsible for causing the disease in 27 animals out of a total of 44. At Kirkee, 338 milk samples from 98 cows and 388 milk samples from 101 buffaloes were tested. *Staph. aureus* was again found to be responsible for causing the disease in majority of animals. (On examination of 112 milk samples from 30 cows and 161 milk samples

from 67 buffaloes, the above findings were again confirmed. Eight animals affected with mastitis due to *Str. agalactiae* were treated with 100,000 units of penicillin G and 5 mg. of cobalt sulphate in aqueous solution inoculated twice at intervals of 48 hours. Six of these responded to treatment. Eighty animals affected with *Staph. aureus* or mixed infection due to *Staph. aureus, Str. agalactiae* were treated with a mixture of procaine penicillin, dihydrostreptomycin, sodium sulphamezathine, cobalt sulphate and distilled water. Except two obstinate cases, all responded to treatment. In three cases of mastitis due to *Corynebacterium pyogenes,* this treatment was repeated four times at intervals of 24 hours. Out of these, two recovered completely, and the third showed considerable improvement. The scheme in Madras was sanctioned from April 1956, but it has not yet started functioning. In Uttar Pradesh, the work was taken up from the 5th January 1956.

Parasitic diseases scheme

This scheme has been running in Mysore with the object of studying the efficacy of chemotherapeutic agents and other measures in the control of liver-fluke disease under field conditions in heavily irrigated areas. It was observed that anti-snail measures, such as drainage, copper sulphate spraying, etc. are neither useful nor practicable. Systematic dosing of the susceptible animals was found to be a cheap and useful weapon for the control of the disease. The total number of dosings and re-dosings done during the year was 1,29,245.

Poultry helminths scheme

This scheme, which was under operation at the Indian Veterinary Research Institute with the object of investigating the factors controlling resistance of poultry to helminths and studying the biology of the common helminth parasites of poultry, terminated on 31st March, 1956. Observations made during the year under report showed that deficiencies of vitamin A and calcium in the diet of poultry significantly increased susceptibility to infestation with *A. galli.* Protein deficiency also increased the susceptibility of birds to this infection, but vitamin D deficiency did not have any effect on the natural resistance of chickens to this parasite. Investigations on the natural resistance of chickens to *Heterakis gallinae* have shown that deficiencies of vitamin A, calcium and protein in the diet did not significantly affect resistance to this parasite. It was observed that, in the case of *A. galli,* the heavy dose of primary infestation prevented the development of light secondary infestations in chickens. The eggs of *A. galli* were found to remain viable for at least 6 months in culture media under laboratory conditions.

The schemes for the (i) investigation of diseases caused by anaerobes, (ii) development of a suitable vaccine for the control of foot-and-mouth disease and (iii) investigation of tuberculosis and Johne's disease, which were operating at the Indian Veterinary Research Institute, have terminated and the results achieved under these schemes have already been reported last year.

Two new schemes were sanctioned in West Bengal during the year under report, for (i) undertaking studies on mycotic diseases

in domestic animals and (ii) studying the life history and bionomics of *Eurytrema pancreaticum*, *Fasciolopsis buski*, *Gastrodiscoides hominis* and *Stephanurus dentatus*.

Bearing of nutrition on helminthic infestation

This scheme, which was initiated with the object of investigating the effects of vitamin A, protein, calcium and phosphorus deficiencies independently, as well as of different combinations of one or more of these deficiencies on the resistance of sheep to liver-fluke, paramphistome, lung-worm, stomach worm, nodular worm, and mixed infection, continued to function at the Indian Veterinary Research Institute. During the year under report, preliminary studies on larval stages of *F. gigantica* were made and it was observed that its cercariae emerge from the snail, *Lymnaea acuminata* between 5 p.m. and 2 p.m., the largest number being shed from 7 to 11 p.m. The percentage of snails infected with this parasite has been found to be very low, round about Izatnagar. A preliminary experiment on growing lambs of about 4 months has shown that this parasite matures in about 94 days. This information has been very useful in arranging the experiments under this scheme. Preliminary studies on the cultivation and storage of the infective stages of *H. contortus* and *O. columbinanum* have been completed. The first and second stage larvae of these parasites have been studied. It has been found that charcoal-faeces mixture is the best medium for the development of the infective stages in the laboratory. For storage of the infective stages, the method adopted by Taylor has been found to give good results. Experiments are in progress to study the effect of single and multiple deficiencies in the diet of sheep on their resistance to *Fasciola gigantica* infestation.

Animal health information service

This service, which was initiated by the Council in 1947 with the object of providing latest information to the States and other countries regarding prevalence of important diseases of livestock, continued to compile monthly bulletins and issue them free of cost to all the State Directors of Veterinary Services and Animal Husbandry Departments, the Principals of Veterinary Colleges and the heads of Central and State Research Institutes in India. In addition, these bulletins were supplied to embassies and consulates of many foreign countries. So far, 116 such bulletins have been issued.

Rinderpest

Rinderpest among cattle and buffaloes in India has long been recognised a serious problem and its eradiction in the country was included as an item in the First and Second Five-Year Plans. The work was initiated on a pilot plan basis in the Southern States of the country under the First Five-Year Plan on 1st October, 1954, and was continued as an all-India plan in the first year of the Second Five-Year Plan.

Vaccinations: During the year under report, the work of vaccination, besides being continued in the Southern States of Madras, Andhra, Mysore, and Bombay was also extended to the States of Jammu and Kashmir, Delhi, Punjab, Uttar Pradesh, Bihar, West Bengal and Orissa.

Consequent on the re-organisation of States, the State of Hyderabad ceased to exist and the areas of operation in that State merged with Andhra Pradesh, Bombay and Mysore. The four southern districts of the old Bombay State, *viz.*, Bijapur, Dharwar, North Kanara and Belgaum where the work had been completed under the pilot project, merged with Mysore State.

The number of animals vaccinated and the doses of vaccine produced from the date of inception of the scheme to the end of the year under report were as follows :

Particulars	No. of animals vaccinated	No. of doses of vaccine produced
	Lakhs	Lakhs
Under the Pilot Project (from 1-10-1954 to 31-3-1956)	55.46	75.40
During the year under report . .	53.84	105.73
Total (from the inception of scheme)	109.30	181.13

The number of vaccinations done in each State from the inception of the scheme up to 31st March, 1957 is given below:

Name of State	No. vaccinated up to the end of March 1956 (Pilot-Project)	No. vaccinated during 1956-57*	Total no. of vaccinations from the inception of the Scheme up to March 1957*
Andhra Pradesh	31,04,552	37,40,273	68,44,825
Bombay	10,36,693	4,57,176	14,93,069
Coorg	1,45,497	..	1,45,497
Mysore	9,19,202	6,56,011	15,75,213
Madras	3,40,796	5,25,456	8,66,252
West Bengal	...	5,844	5,844
	55,46,740	53,84,760	109,31,500

*These do not include figures from the States of U.P., Pondicherry, Bihar, Orissa, Punjab, and Delhi, in which the work was started but was confined to the control of outbreaks, and the animals had not been marked.

In the previous year's report, mention was made of 20 quarantine check posts functioning on the northern border of Madras State. Vaccinations in Madras State have, therefore, reference to those carried out on animals passing into Madras State through the check posts. Due to the re-organisation of Madras State, however, some of these check posts were transferred to the new Mysore State. As during the year, mass-immunisation campaign in the areas adjoining Madras State on the North had covered sufficient depth, all the check posts, except the one covering the import of animals of Madras city, were closed down.

It will be observed that the rinderpest eradication programme has already covered a wide area in Southern Indian and, until the end of the year under report, the scheme had operated approximately over an area of 1,10,000 sq. miles. This together with the free areas of Madras and Kerala States totals 1,82,000 sq. miles or roughly one-sixth of the total area of the country. This area has been rendered free from the ravages of rinderpest and no outbreak of the disease had been reported in the area south of the River Krishna until the end of the year under report.

Vaccine production: As the work of eradication has been extended throughout the subcontinent, it has become necessary to have more vaccine production centres. With a view to economise the facilities available in the States for the production of this vaccine have been utilised. The States of Madras, West Bengal, Uttar Pradesh, Madhya Pradesh and Punjab volunteered to place at the disposal of the Government of India, the facilities available at their vaccine production centres for the production of large quantities of rinderpest vaccine required for eradication work. For manufacturing vaccine by modern methods, freeze-drying equipment worth about Rs. 5 lakhs was imported from abroad. During the year under report, West Bengal produced vaccine for its own use and supplied certain quantities required by Orissa and Bihar.

The Indian Veterinary Research Institute continued to produce a major part of the freeze-dried goat-tissue vaccine and the lapinised vaccine, according to schedule. There was no breakdown or interruption in the supplies to the States which were met in full. Quantities of vaccine produced and supplied by the I.V.R.I. during the year are given below:

Vaccine	Quantity produced	Quantity supplied	Quantity supplied since the inception of the scheme
Freeze-dried goat tissue vaccine . .	74,31,050	75,38,950	1,48,69,121
Freeze-dried lapinised rinderpest vaccine .	33,625	15,015	41,825

The above supplies were made to the States of Andhra, Hyderabad, Bihar, Bombay, Coorg, Delhi and Mysore.

In all, 123 batches of freeze-dried goat-tissue vaccine were manufactured and, of these, every fifth batch was standardised, using hill bulls or buffalo calves for titration. The results showed that the titre obtained in these two species compare favourably, indicating that these animals can be used as a routine for titration of freeze-dried goat-tissue vaccine. According to the recommendations of the Central Rinderpest Control Committee, titration trials were also made on goats and the results equated with those obtained on hill bulls and buffalo calves. No co-relation was, however, found.

Due to lack of proper air-conditioning, the I.V.R.I. obtained a titre of 1:8000 in about 37 per cent of the vaccine batches and as a result of this, the vaccine production could not be stepped up to the fixed target.

Research on rinderpest vaccine (I.V.R.I.): The scheme for the improvement of various rinderpest vaccines and to determine their keeping quality continued to function at the I.V.R.I. In order to obtain certain essential basic information required by the field staff regarding the keeping quality of freeze-dried vaccine, the technical programme of this scheme was revised and amplified. Viability tests carried out with freeze-dried goat-tissue vaccine indicated that this vaccine was fully viable when stored at 25°C up to 19 days, at 5°C for 3 to 10 months, at 37°C for 4 days. After re-constitution, freeze-dried vaccine has been found to be viable up to 6 hours at 25°C, 8 hours on ice, 2 to 6 hours at 38.50°C.

During an outbreak of rinderpest, the animals immunised with lapinised vaccine five years earlier remained unaffected, whereas 19 per cent of the unvaccinated animals in the same herd contracted the disease, of which 22 per cent died.

Work in the Kashmir Valley has revealed that the cattle there can be satisfactorily immunised using G. T. vaccine. Experiments to determine the suitability of goat-tissue vaccine for vaccinating animals in other hill areas are in progress.

Statistical study: A statistical study to assess the progress of the work done during the year brought out useful information with regard to the percentage of cattle and buffaloes vaccinated, the average number of doses of vaccine used per 100 animals and the proportion of time taken for the different field operations. A similar study of the economics of field operations and vaccine production was also made. These studies are being continued.

Land Quarantine Stations: On the recommendations of the Rinderpest Committee, a Quarantine Officer was appointed with effect from January 1, 1957, to survey the country's land frontiers, cattle trade routes, etc., with a view to establishing land quarantine stations for checking the ingress of disease into the country from the neighbouring areas. This officer undertook a survey of the Uttar Pradesh-Nepal border and has submitted a comprehensive report suggesting various places where quarantine stations may be established and also a pattern for such stations. The survey of other border areas is being continued.

Preparation of propaganda material: A sum of Rs. 10,000/- was allotted for this purpose and the preparation of posters and leaflets was started. The leaflets with translations in regional languages and blocks have been sent to the States for producing required quantities of these, while posters are being prepared by the Council for distribution. When more funds are allotted next year, the preparation of other articles for audio-visual publicity will be taken up. It has been suggested that the publicity regarding the Rinderpest Scheme may be taken up through the State Publicity Officers, local radio stations, seed stores, co-operatives and village level workers.

International co-ordination: At the third Regional Conference of the F.A.O. held at Bandung in October, 1956, it was recommended that the F.A.O. should take the initiative in helping member-Governments to co-ordinate their efforts for the eradication of rinderpest.

Accordingly, the services of a F.A.O. expert, Dr. J. R. Hudson, assigned to Burma, Thailand and Viet-Nam, were placed for a period of one month at this country's disposal.

An informal conference between India and Pakistan was also held under the auspices of the F.A.O. to discuss different problems of control of rinderpest in the bordering countries and to adopt measures to check the spread of disease from one country to another.

The under-mentioned recommendations made at this Conference have been communicated for consideration to the Governments concerned :

1. That the campaign, which is of the greatest importance to the economy of all Asian countries, should receive the fullest support of the various Governments concerned at all levels and all possible assistance from such international agencies as F.A.O. ;

2. That to ensure mutual confidence, meetings at frequent intervals between veterinary representatives should be encouraged by the Governments concerned so that the progress of the campaign and future plans can be discussed ;

3. That interchange of disease reports between the veterinary authorities of the countries at monthly intervals should be instituted; in order to avoid delay occasioned by transmission through diplomatic channels, Governments be asked to permit such reports to be sent direct from one veterinary authority to another. Such reports might as well include all the important epizootic diseases ;

4. That the occurrence of outbreaks of rinderpest in border areas should be notified by telegram by the Director of the border State to his counterpart in the neighbouring country ;

5. That priority should be given to the establishment of immune belts on each side of international boundaries. To achieve this satis-

factorily, the work should as far as possible be carried out on both sides simultaneously. Such belts are particularly important where seasonal grazing migrations occur across the boundary and should be sufficiently deep to cover the area of the migration. Immunized cattle and buffaloes should be suitably marked;

6. That quarantine stations or check posts should be established along specified cattle routes to control the movement of cattle and buffaloes across the border so as to ensure that only vaccinated cattle and buffaloes are allowed to cross;

7. That to meet the request of importing countries, arrangements should be made for all animals destined for export to be properly vaccinated against rinderpest before shipment;

8. That the F.A.O. should be requested to provide a Veterinary Liaison Officer to assist in co-ordinating control schemes between Pakistan, India, Afghanistan, Nepal and Ceylon.

9. That research on the preparation of improved rinderpest vaccines and on the duration of immunity produced by the present vaccines should be encouraged.

Dairying

Scheme for the survey of bacteriological quality of milk produced in Kaira District--Anand

The scheme was started on 1st September, 1955 with a view to introducing quality control, standardising the processing, manufacturing, packing and storage conditions of milk and to evolve suitable measures for improving the keeping quality of milk and milk products.

For this purpose, a systematic survey was conducted in Kaira district to collect information on the condition of milch animals and their surroundings, types of vessels and milk measures used, methods of transportation of milk, conditions prevailing at different collecting centres etc. The survey covered 2,25,000 producer-members in 64 societies affiliated to the Milk Union. Eighty-five samples of milk from different producers-societies, 494 samples from the Milk Union and 186 samples of pasteurised milk were examined for their bacteriological quality. The average quality of milk supplied by different societies was found to be of a low bacteriological standard. The bacterial counts of the samples varied from one to ten million per ml. during winter and from 10 to 20 million per ml. during summer. The thermodurin counts of pasteurised milk ranged from 1,000 to 50.000 bacteria per ml. during winter. Further studies on the microflora are being continued.

During the study of bacterial contamination of milk utensils, it was observed that the average bacterial count of milk-collecting trays was 6·7 millions per square inch in winter and 34 millions per square inch in summer. A similar study was also conducted on cans, collection tanks, etc. at the Union. It was observed that unhygienic conditions of handling, combined with the influence of high temperature, were responsible for the production of milk of low bacterial quality. The quality of pasteurised milk at the Union Dairy was

satisfactory, indicating the efficacy of processing methods and absence of post-processing contamination.

Pasteurisation of milk in relation to destruction of pathogenic bacteria and improvement in keeping quality at the National Dairy Research Institute, Karnal

This scheme commenced from June, 1955, at the Southern Regional Station of the Institute at Bangalore. The object of the scheme was to critically examine whether the existing methods of pasteurisation ensured complete destruction of human pathogenic organisms in milk and to determine whether any modifications in the time and temperature of heat-treatment of milk for improving keeping quality were necessary.

During the year under report, 150 samples of raw and commercial pasteurised milk were collected from two private milk-distribution centres and two organised dairy farms and examined for their bacteriological quality. It was observed that the keeping quality of raw milk samples was more or less similar, both in winter and summer, when the milk was held at a constant temperature of 32°C. It was further observed that after pasteurisation, while bacterial count was reduced by 90 to 95 per cent, the corresponding improvement in keeping quality was only about 50 per cent over the keeping quality of the raw milk samples. Apparently the surviving flora multiplied rapidly at the incubation temperature of 32° C and brought about spoilage of pasteurised milk. During the investigation it was also observed that the quality of laboratory pasteurised milk was always superior to that of the corresponding samples subject to commercial pasteurisation. The data on the heat resistance of pure cultures of six common species of milk bacteria inoculated into sterilized whole milk and skimmed milk and, thereafter exposed to heat-treatment for time intervals varying from 5 minutes to 30 minutes had been collected. Further studies will be continued.

Preparation of dairy sanitizers for use in organised village production units

This scheme commenced in June, 1955, at the Southern Regional Station of N.D.R.I. at Bangalore with a view to test the comparative detergent and germicidal efficacy of the different cleaning materials and chemicals commonly available and to prepare a suitable mixture for use under village conditions. A survey was conducted to study the indigenous methods of cleaning milk utensils, types of utensils used and cleaning materials available in the country. Considerable information was collected from the literature available, through correspondence and by personal visits to different centres. Various cleaning materials were analysed for their detergent properties. The preliminary trial with *Reh*, an alkaline earth obtained from Uttar Pradesh, indicated the possibility of using it as detergent in cleaning utensils under village conditions. *Reh* mixed with washing soda was found to be more efficient. Under laboratory condition the brush was used and complete removal of milk residue was achieved.

Utilisation of by-products of Indian Dairy Institute, Bangalore

The scheme was started in June, 1955, with the object of evolving suitable techniques for the utilisation of by-products of ghee

and butter industries, to design necessary out-fit and equipment suitable for use in cottage industry and to work out the economics of utilisation.

During the investigations on the influence of hand and power separators on the composition of resultant skimmed milk, it was observed that the methods of separation of milk had no influence on the composition of skimmed milk. It was further observed that when the fat percentage in the cream remained up to 50 per cent level, the adjustment of cream screw had no effect on the fat percentage of the corresponding skimmed milk. From this point up to about 70 per cent fat in cream, the fat percentage in skimmed milk tended to increase. A comparative study of buffalo and cow skimmed milk revealed that the former was richer in fat, proteins, lactose and ash contents.

Studies on the variations in the quality of *desi* and creamery butter-milk prepared under different conditions revealed that, in the former case, cow butter-milk contained twice the amount of butter-fat and slightly lower amounts of proteins, lactose and ash as compared to buffalo butter-milk. The use of chilled water at the breaking stage reduced the fat contents of both cow and buffalo butter-milk. Investigations on creamery butter-milk revealed that churning of sweet cream resulted in butter-milk with higher butter content than that of the similar samples of ripened or neutralised cream. Storage studies on skimmed milk indicated that addition of sodium bicarbonate (0·1 per cent) improved the keeping quality slightly, but hydrogen peroxide (0·36 per cent) considerably improved the keeping quality.

A model dehydrating-cum-drying unit has been designed and constructed. On trials (with this unit) the temperature for preliminary desiccation was found to be 180° F and the temperature for drying partially-dehydrated skimmed milk was determined to be 120° F. Further work under the scheme is being continued.

Using Hariana cows for work, I.V.R.I.

The scheme was sanctioned from December, 1952, but work actually started from April, 1953. The object of the scheme was to find out whether Hariana cows could profitably be used for draught, milk production and breeding purposes and to assess the value of this breed in comparison with other breeds for the purpose. In all, 24 cows were selected and divided into two groups of 12 cows each; one group was allotted work. In the beginning, it was decided to take observations for a period of two years, but this period was extended to five years. It was observed that after three months' rest (two months before and one month after calving), a cow needed to be gradually put to work. The maximum hours of work put in by the cows in the third lactation was 2,010 hours and minimum for the same group was 1,446 hours; the average being 1,767 hours. In the case of the second lactation group, the average work-hours worked out to 1,184 and maximum and minimum to 1,936 and 728 respectively. In the case of first lactation, the average work-hours amounted to 551 and the maximum and minimum hours of work put in by this group were 1,442 and 183 respectively.

The average milk yield was 2.553 lb., of milk and 120·8 lb., of butter-fat for the work group and 2,842 lb. of milk and 136·26 lb. of

butter-fat for the no-work group. During the year under report, five work and nine no-work cows conceived. The work under the scheme was being continued. Average calving weights of cows of both groups entering the second lactation was 807·33 and 819·50 lb. for the work and no-work group respectively. Weights of calves at birth and at 3, 6 and 12 months of age were recorded.

Hides and Skins

Manufacture of fat-liquors from indigenous raw materials for leather production from Indian hides and skins

This scheme started functioning in February, 1954, at the Central Leather Research Institute, Madras, with the object of manufacturing fat-liquors from non-edible oils which could replace the imported commercial fat-liquors used for imparting pliability, waterproofness and strength to leather. Eight fat-liquors prepared last year were subjected to further tests and the two most satisfactory ones, *viz.* those from pongam oil and sardine fish oil, were prepared on a large scale in the pilot plant in the Institute and sent to commercial tanneries for thorough trial. The two fat-liquors were found comparable in quality to the imported fat-liquors in tests carried out at the Institute. The cost per pound of fat-liquor from sulphate pongam oil worked out to 11 annas, as against the imported cremol F and cremol S obtained at Rs. 1-12-0 and Rs. 1-4-0 per pound respectively.

Fat-liquors were also prepared on a laboratory scale from tobacco-seed oil, rice-bran oil, cotton-seed oil and gingelly-seed oil. Investigations on the manufacture of neatsfoot oil from the hooves of Indian cattle for liquoring of glazed kids were also conducted.

Improvement of shoe upper and industrial leather

This scheme also started in February, 1954, at the Central Leather Research Institute, Madras. The object of the scheme is to improve the quality of shoe-upper and industrial leather manufactured from Indian hides and skins by chrome and other mineral tannages. Investigations were continued to determine the various products formed during the preparation of tanning liquors from various mineral salts. Glycerol-reduced chrome liquors of an expected basicity of 33¼ per cent were prepared, utilising the heat produced by the reaction. Of the various oxidation products of glycerol, CO_2, acetic, formic, oxalic and glyoxalic acids were estimated in the liquors prepared. Spot tests revealed the presence of glycollic acid in glycerol-reduced liquors, and qualitative analysis of sucrose-reduced and glucose-reduced liquors revealed the presence of lactic, glycollic and tartaric acids components not hitherto reported. Formaldehyde and acetaldehyde appeared to be the main constituents of the aldehydic products in the preparation of glucose-reduced liquors.

Manufacture of leather boards from tannery waste materials

Last year's result showed that, while vegetable leather shavings could be used for making satisfactory leather boards, the chrome leather shavings were unsatisfactory and the board prepared from them was found to be brittle. Further, both types of shavings had first to be de-tannised, and the quality of the boards depended

greatly on the adhesive used. Suitable methods for detannising the shavings and cuttings were worked out. Various adhesives available in India were tried for comparative efficacy along with those used in Germany. The Indian rubber latex was found to be highly suitable. Leather boards on a small-scale were made by mixing varying proportions of vegetable leather shavings and chrome leather shavings and also by mixing these with cellulose fibres like rag pulp, paper pulp and wood pulp, which were found to increase the stiffness of the boards. A few processes have been developed for making, on a laboratory scale, leather boards of dierent stiffness and pliability. A pilot plant was in the process of being set up for the purpose and it is proposed to release the processes for commercial exploitation after further studies. Further work to standardise the processes already worked out and to develop new processes is to be undertaken.

Manufacture of chrome retan leather from cow hides for heavy boots

Studies were undertaken on the different operations of the process of retannage, and the process of liming was studied in some detail. Treatment of cut pieces of web-salted cow hide with lime alone first, and then with sulphide, produced soft and non-cracking leather suitable for ammunition boots. Vegetable tan liquors prepared from Indian leathers were not found to be of sufficiently high concentration and the retanning was done with imported extracts. It has been possible to work out a commercial process of chrome retanning for manufacture of good quality leather from comparatively thin indigenous cow hides for both army and civilian footwear upper leather. Further work is in progress to improve the techniques and to standardise the process.

CHAPTER IV

STATISTICAL RESEARCH

Advisory Work

The Statistical Branch of the Council continued its advisory work relating to the design of agricultural and animal husbandry technical programmes and annual reports of the Council's schemes experiments and the interpretation of their results, examination of and the scrutiny of statistical papers received for publication in the Council's journals. A number of statistical enquiries received from the Food and Agricultural Organisation of the United Nations, Central Government, State Governments, Commodity Committees and other Institutions were also dealt with.

Training

The post-graduate training courses in Agricultural Statistics were conducted by the Council as usual. Six students were admitted to the Diploma 2nd-year course and six joined the Diploma 1st-year course. Twenty-one students, deputed by various State Governments, Central Research Institutes and other recognised Institutions were admitted to the certificate course. Out of these, twelve students joined the senior certificate course and nine joined the junior certificate course. The Food and Agriculture Organisation deputed Shri Hani N. Ghanma, from Jordan, for one year to receive training in sample surveys and agricultural statistics under the auspices of the Council. Shri M. P. Upadhyaya, who was granted a scholarship by the Government of India under the Colombo Plan, for undergoing two year's special training in large-scale sample surveys under the auspices of the Council, left India in September, 1956 after the completion of his training. During the year under report, 10 students were declared qualified for the award of Diploma on the basis of the theses submitted by them. Ten students of the first year Diploma Course, 14 students of the Senior Certificate Course and 9 students of the Junior Certificate Course had been declared successful at the annual examinations held by the Council.

As a part of the training programme, students are required to have first-hand experience of planning, organising and conducting the field-work of surveys for the collection of agricultural data. For this purpose a sample survey study of the farming practices and land utilisation statistics was undertaken by the trainees in Delhi State during the year under report. The trainees were stationed in villages for a period of about two weeks for conducting the field-work. Besides this, a number of educational tours were undertaken. The students of the Diploma Course were taken to the Government Main Experimental Farm, Himayatsagar (Hyderabad); Southern Regional Station of the National Dairy Research Institute, Bangalore; Government Agricultural Farm. Coimbatore; Government Veterinary College, Madras; Central Rice Research, Institute, Cuttack, Indian Statistical Institute, Calcutta and Central Jute Research Institute, Calcutta. They also attended the Indian Science Congress Session at Calcutta. The students of the Senior and

Junior Certificate Courses visited the Government Main Agricultural Farm, Himayatsagar; Central Rice Research Institute, Cuttack; Central Jute Research Institute, Calcutta; Central Potato Research Institute, Patna; Allahabad Agricultural College and Farm, and the Indian Veterinary Research Institute, Izatnagar. At these places the students were acquainted with the various aspects of research in progress and their statistical implications. In addition, the students of the training courses were taken to the Indian Agricultural Research Institute and its farm occasionally to get them acquainted with the research in progress and with layout and conduct of field experiments on various crops. The students also received training in official statistics for about a fortnight in different branches at the Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi.

A special refresher course for Senior Animal Husbandry Officers responsible for planning and guiding research in the field of animal husbandry in the States and Central Institutes was conducted by the Statistical Wing of the Council from the 18th February to 2nd March, 1957, with a view to promoting greater use of modern statistical techniques in animal husbandry research in this country. Thirteen officers from different States and Central Institutes participated in the course. This is the second of a series of the refresher courses proposed to be conducted by the Statistical Wing.

In addition to the above-mentioned training programmes, a short training programme was organised by the Council for the benefit of the Agricultural Marketing Officers at the request of the Directorate of Marketing and Inspection. The programme lasted for about 10 days and included (i) lectures on statistical methods in the analysis of data relating to marketing of agricultural produce, (ii) sampling in surveys and quality control, and (iii) scope of agricultural statistics in India and problems of their improvement.

Training of primary reporting agencies

It was reported in the previous year's annual report that under the aegis of the Indian Council of Agricultural Research and the Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, 72 State Revenue and Land Records Officers, deputed by 23 States, received training in statistics. The purpose of the training was to acquaint them thoroughly with the new standards, definitions and concepts in improved methods of collections and compiling agricultural statistics. These officers, in turn, were expected to train the State primary 'reporting' agencies in the collection of statistics by improved methods. The training of the primary reporting agencies by the officers is now in progress in various States and is being supervised by an officer from the Council.

About 35 seminars on subjects of current statistical interest and on investigations in progress at the I.C.A.R. were held. Student members of staff and a large number of eminent statisticians participated. The speakers included distinguished statisticians and scientists like Prof. S. N. Roy, from the University of North Carolina, U.S.A.; Dr. P. V. Sukhatme from F.A.O.; Prof. J. Neyman from

the University of California, U.S.A.; Prof. Sewell from the University of Wisconsin, U.S.A.; Dr. F. Yates from Rothamsted Experimental Station, U.K. and Mr. S. S. Koshal from F.A.O. Dr. S. Ghurye from Lucknow University, gave a series of special lectures on his own work on 'Stein'st-statistic'. Prof. R. A. Fisher also visited the Statistics Branch during the year and staff members had very useful discussion with him on their work.

During the year, the F.A.O. placed the services of Dr. F. Yates at the disposal of the Council for reviewing the progress of statistical research and the training undertaken by the Council in the light of the recommendations made by the F.A.O. statistical experts in 1953. Dr. Yates stayed with the Statistical Branch of the Council for a period of about a month, during which the members of the staff had consultations with him on the research projects at hand.

A large number of students from other institutions visited the Statistical Branch during the year under report and were acquainted with the training and research work at the Branch. These included trainees from the International Statistical Education Centre, Calcutta; Indian Statistical Institute, Calcutta; post-graduate students in Statistics, Gauhati University; graduate students in statistics, Presidency College, Calcutta; and post-graduate students in statistics, Andhra University, etc.

Theoretical and Applied Research

Under the scheme for the award of fellowships for conducting research in agricultural and animal husbandry statistics, Sarvashri S. K. Banerjee and S. G. Mohanty were awarded fellowships during 1956-57. Shri Banerjee worked on the problem of distribution of quasi-ranges and perpared the following papers for publication: (i) "Distribution of quasi-ranges from non-normal populations" and (ii) "Joint distribution of two consecutive quasi-ranges from non-normal populations." Shri Mohanty worked on the problem of estimation of the median effective dose in quantal response data and his thesis on "some properties of a sequential procedure for estimating ED 50 in quantal response data" has been accepted for the award of Diploma in Agricultural Statistics.

Shri Brij Mohan Lal joined the Council in the latter half of the year under report as a Research Fellow for the Ph. D. degree in Agricultural Statistics.

The following papers were prepared and/or published by the Statistical Branch during the year under report:

Shri Daroga Singh . . .	"On efficiency of sampling with varying probabilities without replacement". *J. Ind. Soc. Agri. Stat.* Vol. 1.
Dr. B.V. Sukhatme . . .	"On certain two-sample non-parametric tests for variances". - *A.M.S.* 1957.
Dr. K. S. Krishnan . . .	"A new sire index for milk production."
Dr. B.V. Sukhatme . . .	"Joint asymptotic distribution of the medium and U-Statistics"-*J.R.S.S.* 1957.

Shri M.N. Das	"On parametric relations in a balanced incomplete Block Design"-*J.Ind.Soc.Agri.Stat.* Vol.VI. No. 2.
Shri M.N. Das . . .	"Latin squares with several missing plots"-*J. Ind. Soc. Agri. Stat.* Vol. VII No. 2.
Shri M.N. Das	"Missing plots in partially balanced and other incomplete block designs"-*J.Ind.Soc. Agri. Stat.* Vol. VII Nos. 1 & 2.
Dr. T.V. Narayana and Shri S.G. Mohanty.	"A note on difference equations and combinational identities arising out of coin tossing problems" *J.I.S.A.S.* Vol. VII Nos. 1 & 2.
Dr. A.R. Roy . . .	"On X^2-statistics with random intervals", Stanford University, U.S.A.

Dr. V. G. Panse, Statistical Adviser to the Council, took part in the Training Centre in Statistics in Mexico under an F.A.O. assignment. He also visited Egypt and advised the Egyptian Government on planning improvement of agricultural and fisheries statistics during his stay there for two months.

Dr. G. R. Seth, Deputy Statistical Adviser to the Council, visited Thailand as F.A.O. expert to initiate a sample survey for estimating rice production in that country. He was there for about four months and returned to India in January, 1957.

Research surveys on pepper, 1956-57

The data collected in the sample survey for estimating area and yield of pepper crop in the States of Madras and Travancore-Cochin during 1955-56 were statistically analysed and the preliminary report was prepared. The report was considered by the Statistical Committee of the Indian Council of Agricultural Research in March, 1957.

The average yield of dry pepper per bearing standard was calculated as 28·5 oz. with a sampling error of 2·2 per cent in Travancore-Cochin and 22·8 oz. with a sampling error of 4·7 per cent in Madras. The estimated number of bearing standards for the entire State of Travancore-Cochin and Madras were 17·5 and 15·9 millions respectively. The total production of dry pepper was thus estimated at 14,191 tons with a sampling error of 5·5 per cent for Travancore-Cochin and 10,103 tons with a sampling error of 9·3 per cent in Madras. In both the States the most commonly-used support was *Murukhu* which covered nearly 23 per cent of the total population of standards in Travancore-Cochin and 41 per cent of that in Madras. The important varieties of pepper grown by the cultivator in Madras were *Kalluvally, Balanokotta* and *Nadam-valley* and in Travancore-Cochin were *Kanniakadan, Kottanadan, Narayakodi* and *Karimundi.*

In continuation of the sample surveys on pepper crop, another extension survey was conducted during the year under report in the present Kerala State. The field work which commenced on November, 1956, is expected to be over by the end of May, 1957.

Survey of fertilizer practices

Two pilot sample surveys were initiated during 1954-55 in West Godavari District of Andhra State and Coimbatore district of Madras State. A similar survey was conducted during 1955-56 in Shahabad district of Bihar State. The data received from these districts were analysed.

West Godavari: Thirty-eight per cent of the cultivated area was observed to be manured by FYM and compost, 22 per cent by ammonium sulphate, 19 per cent by penning, 9 per cent by oil cakes, 4 per cent by superphosphate and 4 per cent by other fertilizers. The actual rate of application per acre of ammonium sulphate to paddy, the major crop, was found to be 83 lb., to tobacco, 189 lb., and to sugarcane, 425 lb.

Coimbatore: Seventeen per cent of the cultivated area was benefited by FYM and compost, 6 per cent by penning, 4 per cent by ammonium sulphate and 2 per cent by oilcakes. The rates of application of ammonium sulphate to paddy, millets, sugarcane, tobacco and cotton were estimated at 178 lb., 79 lb., 70 lb., 126 lb., and 58 lb.; respectively.

Shahabad: As the receipt of the returns from Shahabad district was very poor, detailed analysis could not be conducted.

A pilot survey has now been undertaken in the Barabanki district of Uttar Pradesh. The field work is in progress.

Fertiliser demonstration trials on cultivators' fields

The Fertiliser Demonstration Trials Scheme on cultivators' fields was initiated in March, 1954, by the Government of India in collaboration with the Technical Co-operation Mission, which agreed to supply the fertiliser free of cost. The transportation cost of the fertiliser to the locations specified by the State Governments was met by the Government of India. The purpose of the scheme was to demonstrate the effectiveness of the fertiliser to the cultivators in increasing the crop production. Under the scheme, three plot demonstrations were carried out throughout the country on various crops. The scheme continued in the year 1955-56. The data relating to *kharif*, 1955, and *rabi*, 1953, were analysed. The results are given below:

Kharif, 1955: The results of 7,000 demonstrations, received from Madras, Mysore, Coorg, Travancore-Cochin, Andhra, Orissa, West Bengal, Assam, Madhya Pradesh and Jammu and Kashmir were summarised.

Response to 30 lb. nitrogen was good in all the States and on all the soil types; it varied from about 4 md. per acre in Madras State to about 8 md. per acre in Mysore State. The response to nitrogen was very high on old alluvium, red-soils and red-gravelly soils (8 to 10 md. per acre to 30 lb. N per acre.) The extra response to phosphate over nitrogen was moderate to good on all soil types and in all the

States. The average extra response to 30 lb. P_2O_5 per acre varied from 2 md. per acre in Jammu and Kashmir and West Bengal to 6·83 md. per acre in Mysore State. The response to mixed fertiliser (12:6:0) at 300 and 450 lb. per acre was good on all soils and in all the States the average response at 300 lb. per acre varied from 4 to 9 md. per acre, and with the increase in the level of the fertiliser to 450 lb. per acre, the average increase varied from 3 to 5 md. per acre. Urea has given better response in comparison to ammonium sulphate and ammonium sulphate nitrate ; the difference varied from 1 to 3 md. per acre.

Application of nitrogen in the form of ammonium sulphate gave an average profit of Rs. 31 per acre; and the application of phosphate gave an additional profit of about Rs. 19 per acre. The application of mixed fertiliser at 300 lb. per acre has shown a profit of Rs. 9 per acre ; for the calculation of economics of manuring, the price of 1 md. of paddy was taken to be Rs. 10.

Rabi, 1955: The results of 5,000 demonstrations were summarised ; these were received from most of the wheat growing States—Punjab, Bombay, Madhya Pradesh, Pepsu, Vindhya Pradesh, Madhya Bharat, Rajasthan, Kutch, Delhi, Ajmer, Hyderabad and West Bengal. Results of the report are summarised below :

Moderate to high responses were obtained in all the States with the application of 30 lb. N per acre. The responses were particularly high in Punjab, Delhi and Madhya Bharat, being more than 4 md. per acre. On the average, responses varied from 2 to 4 md. per acre. Additional response to phosphate at 30 lb. P_2O_5 has given a moderate extra response in all the States and on all the soil types. It varied from 1·3 md. per acre in Vindhya Pradesh and West Bengal to 3·3 md. per acre in Madhya Bharat. The application of mixed fertiliser (2:6:0) at 330 lb. per acre and 495 md. per acre has also shown a good response. Average response at 330 lb., per acre was 3:5 md. per acre and to 495 lb. per acre being 6:5 md. per acre. No significant difference in response had been observed between different sources of nitrogen.

The application of nitrogen has shown a profit of Rs. 24 per acre. The application of phopsphate gave an additional profit of Rs. 17 per acre. The application of mixed fertiliser has shown a profit of Rs. 4 and Rs. 17 at 330 lb. per acre and 495 lb. per acre respectively. The cost of 1 md. of wheat was taken to be Rs. 14 per acre for the calculation of economics of manuring.

Analysis of Bihar manurial trials on cultivators' fields

Simple six-plot manurial experiments numbering about 2,000 in all were conducted on cultivators' fields during 1955-56, also, in a number of thanas in each district of Bihar. As regards crops covered, types of experiments chosen for each crop and the manner of selection of sites for experimentation, these experiments were exactly similar to those conducted in the previous two years.

The data were analysed during 1956-57. The method of estimating the responses for the different treatments for the geographical areas, namely districts, and for soil *versus* geological classifications proceeded in the same manner as in the last two years, as also the method of estimating the standard errors of the responses. The standardised responses facilitating comparison of responses in the

various years have also been calculated. The following table gives the average responses for the whole State for 1955-56, for important crops and levels of fertilizers. The numbers in brackets give the number of experiments on which each average is based.

Treatment	Paddy	Wheat	Maize	*Maruwa*
25 lb. N . . .	5·96 (709)	3·68 (651)	3·71 (356)	3·43 (150)
50 lb. N . . .	8·18 (494)	5·35 (472)	6·17 (356)	5·03 (150)
20 lb. P_2O_5* . .	3·42 (709)	2·34 (651)	2·31 (356)	2·05 (150)
40 lb. P_2O_5* . .	4·64 (494)	3·59 (472)	3·50 (356)	3·55 (150)
20 lb. K_2O** . .	1·34 (465)	1·48 (420)	1·80 (356)	1·01 (150)
40 lb. K_2O** . .	1·52 (459)	1·44 (410)	..	..

The statement shows that, as in the previous two years, nitrogen alone and phosphate in conjunction with nitrogen gives good responses; Bihar soils respond to potash also in the presence of both nitrogen and phosphate. Again, as in the previous two years, 40 lb. phosphate in the presence of 25 lb. N in the form of super gives better response than in the form of bonemeal for all important crops, the increase in response due to 40 lb. super in the presence of 25 lb. N being of the order of about 3 md. per acre over 40 lb. bonemeal in the presence of 25 lb. N.

Scheme of National Index of Field Experiments

The scheme of National Index of Field Experiments was sanctioned by the Indian Council of Agricultural Research with the aim of preparing an inventory of all the agricultural field experiments conducted by the States and diverse authorities in India from 1935 onwards. The main objective of the scheme is to make available to all interested research workers in the country at one central place a record of the results of all agricultural field experiments.

The scheme was launched in October, 1955, by the Indian Council of Agricultural Research. Three proformas have been designed, one each for annual, perennial and cultivators' field experiments. In each of the States into which the country has recently been divided, the field staff consists of one statistical assistant assisted, in some cases, by one or two computors. The total field staff consists of 13 statistical assistants and 5 computors. The field staff works under the supervision of the Regional Supervisor who is either a State Statistician in the Department of Agriculture, or the Director of Agriculture, or the Principal of an Agricultural College.

The statistical assistant is primarily responsible for collecting data in respect of each experiment conducted from 1935 to 1953 and also to conduct statistical analysis wherever necessary and to fill in the prescribed proformas. The filled-in proformas are to be sent to the headquarters of the Indian Council of Agricultural Research. For experiments from 1954 onwards, the States are expected to get the

proformas filled by their own officials. The Regional Supervisor helps the assistant in making contacts with each experimental station in his jurisdiction for getting full information regarding experiments and the assistant personally visits the stations whenever necessary. The proformas when received in the Indian Council of Agricultural Research are scrutinised and the calculations checked.

The work under the scheme, which has now been running for one and a half years, is satisfactory in all the States except Assam, Madhya Pradesh and Orissa, where the staff is being appointed. The total number of experiments summarised by the field staff so far is of the order of 2,000. Cards of size 5 in. by 8 in. have been prepared and the transfer of the information from the proforma on to the index cards has just now begun.

Scheme for study of milk-yield breeds and management practices of bovines in Punjab, 1956-57

A five-year scheme for evolving a suitable sampling technique for collection of data on milk yield and animal husbandry practices of bovines in the country has been approved by the Planning Commission and included in the Second Five Year Plan. The first year's programme of the scheme was implemented in the former States of Punjab and PEPSU of the Northern animal husbandry region during 1956-57.

The plan of work adopted under the scheme was as follows: The area was divided into three zones on geographical basis which formed the strata. A sample of five tehsils was selected from each of the zones. The field work in each of these tehsils was spread over the three seasons of the year, *i.e.,* summer, rainy season and winter, covering the 12 month period of the year. In each of these tehsils, a sample of two clusters of three neighbouring villages each, or one such cluster and two towns with one ward in a town were selected at random for each of the seasons. One *ad hoc* enumerator was kept in charge of the field work in each tehsil. The field work in each of the villages or wards was spread over a certain number of rounds in each season. During the first round, in the case of rural areas the enumerator would stay for a fortnight in each cluster of villages. The first eight days would be spent making complete enumeration of the bovines and also in collection of other particulars of these animals by enquiry. During the subsequent six days of the fortnight, he would select two random clusters of three contiguous households in each of the villages of the cluster and collect detailed data in one such cluster on each day like the weighment of the milk yield for two of the animals in milk, selected randomly from each household, both in the morning and evening periods, and also making a physical weighment of the various types of feed given to the different animals in the households. He would also collect in between the two milking-timings the data by enquiry on the breed, the stage of lactation of the animals in milk, and other animal husbandry practices of the bovines in the selected households. As regards the urban areas an enumerator would stay for one week in the selected ward. He would spend the first four days in the week making a complete enumeration of the bovines and the subsequent two days in that week for collection of detailed

data on milk-yield and animal husbandry practices. The field work in each of the subsequent rounds consisted of selecting four random clusters of households in each of the villages and five clusters in each of the wards for detailed study at the rate of one cluster each day. In addition to this study, he would also select eight clusters in each village and 10 clusters in each ward for estimation of changes in the bovine stock during the intervening period of his visits.

The field work was entrusted to the 15 *ad hoc* enumerators and their work was supervised by three supervisor-cum-enumerators, three Inspctors and one Field Officer. A supervisor was primarily required to work as a substitute in the place of an enumerator whenever he (enumerator) was on leave due to sickness or other reasons, and also to carry out supervision on other days. An inspector, besides exercising supervision of field work, was also made responsible for collection and scrutiny of the data and for its onward transmission to the I.C.A.R. headquarters. The Field Officer was in charge of overall supervision of the field work of the scheme.

An interim report giving the results of the data collected during the summer season has been brought out and placed before the Statistical Committee at its meeting held in March, 1957. A detailed statistical analysis of the data collected during the three seasons is in progress.

Sample survey for estimating the out-turn of paddy (Central Mechanized Farm, Nandpur, Jammu and Kashmir State)

The Statistical Wing of the Indian Council of Agricultural Research conducted a sample survey for the estimation of the total out-turn of paddy during the year 1956 at the Central Mechanised Farm, Nandpur, Jammu and Kashmir State. Due to late receipt of information, the conduct of the survey was delayed. The sample survey was confined to *Basmati* variety only, covering 52 per cent of the total area (1,062 acres) under paddy, as the area sown under early varieties like Janna, T. 21, etc. was already harvested before the commencement of the survey.

The area under *Basmati* was estimated at 567 acres with a sampling error of 0·25 per cent. This area is only 0·5 per cent in excess of the area reported.

Scheme for evolving a suitable technique for ascertaining the cost of production of milk

The objective of the scheme and the plan of the field work to collect data in order to evolve an appropriate technique for assessing the cost of production of milk in the urban and rural areas of Delhi have been mentioned in the annual report for 1955-56. During the period under report, the data collected during the second year of the enquiry, *viz.* 1954-55 were analysed statistically and the results presented to the *ad hoc* Milk Costing Committee.

The outstanding aspects of these results are given below:

1. The overall estimates of the net cost, including the cost of family labour charged at the market rates, work out to 47·5 nP per

seer of milk in the urban area and 35·8 nP. per seer of milk in the Delhi villages with standard errors of 1·8 and 1·3 nP. per seer of milk respectively. Thus, these estimates are well within the degree of precision aimed at, *viz.*, less than 6 nP. per seer of milk for both urban and rural tracts.

2. In the urban area, the cost of milk production is the least for large-sized stables (containing over 14 animals) but increases as the size of the stables increases from two or less to 6 to 14 milch animals. In the villages, the estimated cost for the cultivator-owners is about 3 nP. more than for the non-cultivator owners; similarly the cost is slightly more for private than for commercial producers. The main reason for these results is the presence of a larger number of dry animal and lower milk yield in stables of private and cultivator-owners.

3. In both urban and rural sectors, the production cost is the highest in winter and the least in the rainy season. The availability and the cost of feeds seem to be largely responsible for this variation.

4. Of the total net cost, the feed cost accounts for as much as 64 per cent in the city area and 68 per cent in the villages. The other major component is the depreciation on animals (20 per cent.) in the urban area and the unpaid labour (20 per cent) in the rural area. A similar trend is observed from the analysis of the first year's data.

5. The percentage of milch animals that are in milk is the highest in stables having a larger number of buffaloes than cows, *viz.* the urban stables which are of medium size (containing 3 to 14 milch animals) and the rural stables which belong to the non-cultivator, commercial class of producers.

6. The average daily milk yield per milch animal is 7·2 seers and 2·6 seers in the urban and rural areas respectively. In both these areas, the milk-yield is the highest in winter and lowest in summer.

Analysis of cattle breeding data

Studies pertaining to the breeding of the Kankrej herd maintained at the Institute of Agriculture, Anand, during the period February 1956, and on the age at first calving and the generation interval of different herds were carried out.

Kankrej herd at the Institute of Agriculture, Anand

The lactation records analysed numbered 361 from 111 cows. The number of bulls used on the herd was 21. The records were spread over four generations, including the foundation stock.

It was observed that there was a significant improvement in the performance in respect of milk yield of the herd at the end of the period of study as against that at the commencement. The average first lactation yield of the herd on April 1, 1956 was 4363.155 lb. as compared with an average of 2914·131 lb. for the first lactation on the farm for the foundation stock which mostly pertained to the first and second generations.

By comparing the average performances in different generations, it was observed that the increase in milk yield from generation to generation was significant. Dam-daughter comparisons over like-lactations confirmed this finding.

An examination of first-lactation yields commencing in different years has shown wide fluctuations. This environmental variation was disentangled from the variation between generations by the method of fitting constants. It was observed that the improvement from generation to generation was no longer significant, whereas the variation attributable to different periods showed a linear trend, thus indicating that the improvement shown earlier may mainly be attributed to the improvement in general conditions of feeding and management which did, in fact, take place.

The estimates of heritability obtained by doubling the intra-sire regression of daughters' performances on their dams were found to be low for all important milk characters and were estimated with low precision, owing to the small number of observations on which they were based. However, the estimate for the age at first calving was surprisingly high (0·66 to 0·24 based on 41 d.f.). Subject to substantiation by additional data, the result indicates that there is scope for reducing the age at maturity through proper selection without having resort to any such practice as feeding on a very high level of nutrition of the heifers, which showed a deleterious effect on the performance of the cows, when attempted on a small scale on the farm.

Out of the 21 bulls used on the herd, only two bulls had sufficient number of pairs of daughter-dam records for progeny-testing.

Although the superiority of the daughters of one of the two bulls (Dhordi 41-10) over their dams was to be largely ascribed to improvement in environmental conditions, a critical comparison revealed this bull to be superior to the other. The corrected daughter-average index for this bull was 4,461·245 lb. as against a herd average of 3,650 lb. for the first lactation.

Study of the age at first calving and the generation interval

Delayed maturity, along with long calving interval, is a major cause of the uneconomic nature of dairying in India. A reduction in the age at first calving, apart from making maintenance of cattle more economical, will be helpful both for early selection of female stock on the basis of their own performance and for early progeny-testing of bulls. The information available on the age at first calving and the generation-interval collected for some herds during previous years was summarised.

The average age at first calving was about 42 months for the Red Sindhi herds maintained at the I.D.R.I. and Hosur. It was higher for all other herds, being of the order of 44 months for Kangayam herd at Hosur; and 47 to 49 months for Gir herd at I.D.R.I., Kankrej herd at Anand and Tharparkar cows at Patna.

Data relating to the age at first calving of village cattle in the States of Punjab and PEPSU recently gathered in the course of a

survey under a Council scheme for the study of milk yield, and feeding and rearing practices of cattle indicated that it was of the order of 47 months for cows and 51 months for buffaloes.

The average inter-generational interval was worked out by calculating the mean interval separately from cow to daughter, cow to sire, bull to daughter and bull to sire, and then averaging them. It was of the order of about six years for the Red Sindhi herd at Bangalore and the Kangayam herd at Hosur, and about eight years for the Thaparkar herd at Patna.

Statistical analysis of the data collected under the Indigenous Goat Breeding Scheme, Punjab

This scheme pertaining to the Beetal breed of goats started in December, 1939 at the Government Livestock Farm, Hissar and is due to terminate in March 1959. Data collected from the inception of the scheme up to the end of March, 1957 on the farm are being analysed. The items of study include the improvement ascribable to breeding, the effect of season of kidding on kid-morality, genetic variability present in the flock in respect of important characters, sire-evaluation, progeny tests and other related studies.

During 1956-57, the data pertaining to the scheme were collected and compiled. Some studies such as kid-mortality, performance in respect of milk yield in different generations and lactations have already been undertaken.

The infantile mortality among the kids is quite high and is of the order of 25 per cent. Attempts are being made to study whether this mortality is a heritable character.

Further work of analysis is in progress.

Statistical analysis of milk-composition data

The data collected in the co-ordinated schemes for formulating the legal or presumptive standards of market milk for fat, solids-not-fat and density in the States of Punjab, Bihar and Bengal during 1949-52, 1951-52 and 1952-53 respectively, were taken up for statistical analysis. The data with regard to the milk samples collected from Bihar have been analysed and the salient features of the results are summarised below:

This study deals with 2,847 random samples of milk (both morning and evening) from cows and buffaloes of different breeds. These samples were collected from Patna town, suburbs and surrounding villages from which milk was supplied to Patna. The field work was spread over all the seasons of the year, *viz.*, winter, summer and monsoon.

It is observed, as expected, that buffalo milk is on an average richer in fat (6·3 per cent as against 4·5 per cent) as well in solids-not-fat (9·1 per cent as against 8·6 per cent) and has also a slightly higher density (1·0283 as against 1·0278) as compared with cow milk. Buffalo milk is seen to have a lower density and a lower solids-not-fat content in summer as compared with the other two seasons, whereas the fat content is lowest in winter. In the case

of cow's milk on the other hand, all the three characteristics were higher in winter and lower in the other two seasons. The average fat content, as well as the solids-not-fat content, of morning samples of buffalo milk is higher than that of the evening samples, but there is not much difference in density. In the case of cows, the evening milk is richer is solids-not-fat and has a higher density.

The coefficients of variation were highest for fat (23·7 per cent for buffaloes and 22·2 for cows), about one-third as much for solids-not-fat (8·5 per cent for buffaloes and 7·6 for cows) and very small for density (0·28 per cent for buffaloes and 0·25 for cows).

Finally, the tolerance limits corresponding to levels of 1, 2, 5, and 10 per cent for individual sampling of milk for the three characters (ignoring seasons) were estimated directly from the data, normal approximation to the curve and by actually fitting the required Pearsonian curve. It is seen that in the case of fat percentage the normal approximation appears to give too low a limit, whereas the Pearsonian curve seems to give too high a value; for solids-not-fat the normal curve yields a higher, though very much closer, value to the corresponding Pearsonian limit, particularly at the higher levels of 5 and 10 per cent; in the case of density the agreement is very close.

The analysis of data from other States is in progress.

Rinderpest Eradication Scheme

As already mentioned in the Annual Report for 1955-56, the Rinderpest Eradication Campaign was carried out in the States of Andhra, Mysore, Bombay and the quarantine stations of Madras. The progress of work done from the inception of the scheme up to March, 1957 was summarised from the weekly returns received from the field staff. The study of the cost of vaccination per animal and of the time taken for different field operations were undertaken. The salient features of the results are given below:

1. The percentage of animals vaccinated in the villages visited was on an average 72, while the corresponding figure for the quarantine stations was 90.

2. To vaccinate 100 animals, on an average, 122 doses of vaccine have been used by the field staff and 245 doses by the quarantine staff.

3. The average cost of vaccination per animal works to 20 nP., the cost varying from 19 nP to 23 nP., except in Coorg, where the figure was 30 nP.

4. The time taken by field staff for all the three operations, *i.e.* (i) transit from one village to another, (ii) initial preparation, and (iii) actual vaccination, was of the order of 10 hours in Andhra and 6 hours in Mysore, 60 per cent of this time having been utilised for actual vaccination in Andhra, and 54 per cent in Mysore.

5. The co-efficient of correlation between the time taken for actual vaccination per day and the number of vaccinations per individual per day was positive and statistically significant, thereby confirming the earlier conclusion that in the case of parties which

had a higher rate of vaccination per individual, the time taken for the same was also higher.

Agro-economic subjects

Eight new schemes on agro-economic subjects were received during the year under report for financial assistance from the Council. The schemes were considered by the Agricultural Economics Committee and Scientific Committees and the following schemes were sanctioned by the Governing Body:

1. *Scheme for studying the intensive cultural practices on small holdings, Calcutta University* : The object of the scheme is to intensify the cultivation practices and land-use with a view to find out the suitable size of a small holding and the cultural practices which can give the cultivator fairly full employment and sufficient production.

To carry out the study in three villages near the State Agricultural Farm at Burdwan representing, more or less, the agricultural practices as prevalent around the Farm were selected for the experiments. These practices are quite intensive under the influence of the Farm.

In each of these villages, three cultivators were selected on the basis of the total size of their holding, one from each of the following categories:

(a) 0—2 acres;
(b) 2—4 acres and
(c) 4—6 acres.

The holdings of each cultivator were classified into two different categories—high land and low land, the difference being mainly in the matter of irrigation. The high land is well irrigated by artificial means, whereas the low land is mostly rain-fed.

The scheme started functioning in September 1956, but its progress was impeded by devasting floods in the selected villages. New villages and holdings had to be selected. Work so far has been confined to high land blocks only. Detailed data regarding all operations, input of labour and materials have been maintained. Initial soil samples have been collected from all the holdings. The work is in progress.

2. *A study of mechanised farming*: The object of the scheme is to study the investment, output under various degrees of mechanisation with reference to size of farm, crop rotations and facilities of cultivation and to compare the rate of investment, profits and land-use on mechanised farms.

Twelve farms of area between 200 to 500 acres, managed by private enterprise, will be studied and the survey method will be used for the purpose of enquiry.

The scheme has just started functioning and its progress report is still awaited.

3. *Study of farm and non-farm employment in South Arcot District, Madras*: The object of the scheme is to study objectively the nature of employment and intensity of rural unemployment.

The scheme envisaged a programme of study by selecting a sample of about 50 villages specializing in different crops, preceded by a pilot survey of 10 villages representing different types of crops. The scheme has two parts *i.e.* pilot survey and general survey. The Agricultural Economics Committee has recommended for sanction only the pilot survey. The work of the scheme has not so far been started.

4. *Nature and extent of non-farm employment in Thana District, Bombay State*: The object of the scheme was (i) to study the nature and extent of non-farm employment (ii) obstacles to their further development and (iii) steps to be taken to extend them.

On the whole, 539 families have been interviewed, of which non-farm families are 108 and families pursuing farm and non-farm activity are 431. The field enquiry is over and the schedules have been coded and a plan for tabulation and analysis evolved. The statistical analysis is in progress. The scheme has since been terminated and the final report of the scheme is awaited.

5. *Methods and practice of farm accounts, Gokhale Institute*: The object of the scheme was to (i) evolve a Farm Account Book suitable for being maintained by the farmers themselves, and (ii) to evolve methods by which the keeping of farm accounts could be popularized among the farmers.

The field work at the four centres came to an end towards the middle of the year 1956. From these four centres, in all, 275 books of accounts had been received.

Encouraging results were obtained at only two of the four selected centres. In fact, the number of completed books of accounts received from each of these two centres exceeded 100, while those received from the remaining two centres together numbered 24. The scheme is still in progress and has been extended up to the 31st March, 1958.

6. *Award of research fellowship for the economics of multi-purpose River Valley Projects in India*:—The main objectives of the scheme are :

(a) To discover a suitable method of economic appraisal of river valley projects ;

(b) To study the character of regional transformation that is likely to occur and the problems presented by such transformation. In this connection, the absorptive capacity of a particular river valley as regards power and irrigation will be specially studied in the context of existing economic conditions and long-term developments ;

(c) To study how the social benefits expected may be maximised, in order that the social cost of these projects may be commensurate with maximum social benefit in broad accounting terms.

The results of the scheme will appear in the form of a thesis which is expected to be submitted by the Research Fellow in the near future.

Problems requiring special attention

Sampling and operational research: The progress in the development and use of sampling techniques for estimation of crop acreages and yields has been remarkable, to which reference has already been made. It is necessary to develop suitable techniques for estimating the production of fruits, spices and vegetables, animal husbandry products like wool, eggs, etc. and for estimating the incidence of disease and pests on crops. The estimation of damage to the crop and the consequent reduction of yield is a more complicated problem but is worth attempting. The statistical assessment of control of insect pests by means of insecticides through controlled field experiments, bio-assays or sampling study in the field, has received little or no attention in the past in India, and deserves serious study owing to its increasing economic importance. The statistical assessment of the results of the Grow More Food Campaign, for which a technique was developed by the Indian Council of Agricultural Research, is an example of operational research in agriculture. Another fertile field for such research is the study of agricultural and animal husbandry practices in different tracts. It is only through such operational studies that an accurate quantitative assessment of the present condition of farming in relation to the use of implements, manuring, crop varieties and of livestock in relation to breeds, feeding, etc., can be made. Such surveys form the most reliable basis for formulating developments plans and will serve as a benchmark for periodic assessment, and subsequently of the degree of progress achieved in the use of improved implements fertilizers, improved seeds, better breeds of livestock, better standards of feeding etc.

Field experimentation: Very little work has been done for the development of horticultural products. Suitable experimental designs for horticultural crops are urgently needed on the basis of the study of variability of the experimental material. Apart from the long periods required for such experiments, lack of efficient experimental designs has been an important factor in experimental work on horticultural crops lagging far behind that on annual crops.

Similar considerations apply to nutritional and other experiments with animals. Here again, a study of the extent and pattern of natural variability in characters like milk production in cattle, wool production in sheep, egg production in poultry, is required in order to recommend efficient practical designs for these investigations.

CHAPTER V

HIGHER AGRICULTURAL AND VETERINARY EDUCATION

An important measure taken by the Government of India in 1955 was to provide financial assistance to the State Governments for setting up new agricultural and veterinary colleges and to provide increasing and better facilities of teaching in the existing colleges in the various States. This need was felt because of the setting up of Community Projects and National Extension Service Blocks, which require a large number of trained agricultural personnel.

Expansion Programme

All the institutions covered by the expansion programme started functioning during 1955-56 by make-shift arrangements. Their detailed proposals and estimates were received during 1956-57 and were duly sanctioned after scrutiny by a Technical Committee. The quantum of financial assistance sanctioned for the various institutions covered by the programme is detailed below :

	FIGURES IN LAKHS (RUPEES) Grant	Loan
(a) *New Agricultural Colleges*		
(i) Kerala	14·78	4·92
(ii) Punjab	15·38	9·62
(iii) Bihar	15·80	5·27
(iv) Rajasthan	17·56	5·58
TOTAL	63·52	25·39
(b) *Expansion of facilities at the existing Agricultural Colleges*		
(i) Assam	7·56	2·52
(ii) Madras	10·56	3·52
(iii) Andhra Pradesh	3·61	2·21
(iv) Madhya Pradesh	4·77	1·59
TOTAL	26·50	9·84
(c) *New Veterinary Colleges*		
(i) Kerala	2·171	7·23
(ii) Orissa	2·090	6·96
(iii) Madhya Pradesh	1·860	6·20
(iv) Andhra Pradesh	2·10*	..
TOTAL	36·31	20·39
(d) *Expansion of facilities at the existing Veterinary Colleges*		
(i) Assam.	7·45	2·48
(ii) Bihar	2·85	....
(iii) Punjab	7·41	22·59
(iv) Madras	8·12	2·71
(v) Osmania University	1·99	..
TOTAL	27·82	27·78

*Represents the expenditure sanctioned for construction of temporary buildings and purchase of equipment pending a final decision with regard to the permanent location of the college

The assistance is primarily intended to cover non-recurring expenditure on construction of buildings and purchase of equipment, etc., and will be available to the institutions concerned for expenditure over a period of three years. The entire recurring expenditure is the responsibility of the State Governments concerned.

Largely as a result of the above measures a few State Governments started new Agricultural Colleges without central assistance. The number of admissions in Agricultural Colleges increased from 1,292 in 1953-54 to 2,216 in 1956-57 and in Veterinary Colleges from 597 in 1953-54 to 1,205 in 1956-57.

Two-year emergency course in veterinary science

As it takes four years to train a veterinary graduate, a two-year emergency course in veterinary science was started during 1955-56 at nine centres in the States with financial assistance from the Government of India for meeting urgent requirements of trained veterinary personnel in the Community Projects and N.E.S. Blocks. A second batch of these trainees was admitted at seven centres during 1956-57. The total admissions to the course were 843 during 1955-56 and 607 during 1956-57.

Inter-institutional arrangements with American universities

The Government of India have also taken steps to secure necessary equipment for the different agricultural and veterinary colleges in order that they may maintain well-equipped laboratories, farms and libraries. An agreement has been executed with five U.S. Land Grant Colleges who are now working in co-operation with the agricultural research and education institutions in India in order to assist the Indian Institutions in affecting improvements by way of equipment, library facilities and exchange of staff and students. The arrangement provides for assistance in the following directions:

(i) Deputation of 45 experienced staff members from the American universities for teaching and research work in India ;

(ii) Fellowships for 35 Indian staff members for advanced training in selected subjects in U.S.A. It is proposed to make provision for the deputation of 45 additional Indian staff members for advanced training in U.S.A. under the 1957 programme ;

(iii) Class-room, laboratory and field equipment ; including technical books and journals and periodicals not ordinarily available in India. The funds committed up to date for equipment amount to about one crore, and another Rs. 50 lakhs are likely to be alloted under the 1958 programme.

Twenty-two foreign specialists sent by the American Land Grant Colleges have already joined their assignments in India. Eight Indian staff members had already left for advanced training in U.S.A. by the end of March, 1957 and 20 more are likely to proceed to U.S.A. during the next six months. Up to the end of March 1957, lists of books and equipment to the extent of about Rs. 50 lakhs for the institutions covered under the programme had been approved and were at the various stages of procurement.

Report of Joint Indo-American Team

The Government of India appointed in November, 1954 a joint team of Indian educationalists and American specialists to make recommendations for removing some of the critical deficiencies in the existing facilities for agricultural research and education in India. Some of the principal recommendations made by the Team, which concern the Central Government, are as follows:

(i) An annual continuing grant-in-aid of a sum of Rs. 2 crores by the Government of India to State Governments on a population basis, for local research ;

(ii) Central assistance for building up research facilities and machinery in the less developed States ;

(iii) Development of five agricultural colleges and five veterinary colleges (to be selected on regional basis) into strong centres of post-graduate training with substantial grant-in-aid from the Centre ;

(iv) Establishment of five rural universities with substantial grant-in-aid from the Government of India ;

(v) Establishment of extension wings at agricultural colleges.

The report of the Team became available after the Second Five Year Plan had been finalised and no provision could, therefore, be included in the Plan for implementing the above recommendations of the Team. However, the Planning Commission have since agreed to recommendations No. (ii) and (iii) being taken up for implementation during the current Plan, and the details are at present being worked out in consultation with the State Governments concerned. The question of finding resources for the remaining recommendations referred to above is still under discussion with the Planning Commission.

The other recommendations of the Team primarily concern the State Governments and have been communicated to them for implementation.

Short-term refresher course for veterinary teachers

The Joint Indo-American Team on Agricultural Research and Education have in their report observed that the teaching staff employed in various veterinary colleges in India is generally deficient in academic attainment. In order to remedy the situation the Team suggested that refresher courses or seminars might be arranged for the benefit of veterinary teachers. In pursuance of this recommendation, arrangements were made in December, 1956, for holding a seminar of two weeks' duration on the anatomy of domesticated animals at the Rajasthan College of Veterinary Science and Animal Husbandry, under the guidance of Dr. Grossman, an eminent American veterinary scientist. Similar short-term refresher courses in the three other disciplines, namely bacteriology, anatomy and surgery have been arranged during May and June, 1957 ; the bacteriology course has been arranged at the I.V.R.I., while the remaining courses are being arranged at the Bengal Veterinary College, Calcutta.

Improvement of library facilities in agricultural colleges

The Indian Council of Agricultural Research secured the services of Dr. R. R. Shaw, an eminent library consultant of the U.S.A., under the Technical Co-operation Programme, to make a survey of the existing facilities in the libraries attached to agricultural and veterinary colleges and research institutes and to suggest measures for improvement. Some of the important recommendations made by Dr. Shaw are as follows :

(i) Starting of an abstract journal which (a) will let all researchmen know, wherever they work, what work is in progress in the agricultural and veterinary research institutions in India, (b) abstract the published reports of research work in India and (c) abstract a limited number of foreign articles of particular importance for Indian conditions ;

(ii) Photostat service to make any periodical or article needed available to any research worker in India ;

(iii) Book-lending service with a minimu mof requirements such as deposits, and lowered postal rates ;

(iv) Improved bibliographical and reference services from the librarian ;

(v) Production of low-cost teaching materials such as lecture notes and preliminary additions of text books ;

(vi) Provision of additional copies of assigned reading materials in the libraries attached to agricultural and veterinary colleges ;

(vii) Provision of two or three periodicals in each of the subject-matter fields taught in agricultural and veterinary colleges ;

(viii) Reduction of I.C.A.R. library collection to that needed for quick reference for the staff of the I.C.A.R. and expansion of the IARI, IVRI and NDRI collections as the base for national service ;

(ix) Institution of an insurance fund to overcome serious obstacles to the use of books caused by stringent accountability requirements ;

(x) Training of librarians ;

(xi) Agricultural and veterinary college libraries should be kept open outside college hours for the benefit of students.

Recommendations Nos. (i), (ii), (v), (viii) and (ix), which concern the Central Government, are under active consideration. The remaining recommendations require action by the State Governments and have been communicated to them for suitable action.

Indian Council of Agricultural Education

The second session of the Indian Council of Agricultural Education was held at Lucknow during September, 1956. The Vice-Chancellors of the Universities of Allahabad, Agra, Orissa and

Principals of the various agricultural and veterinary colleges attended the season. The principal recommendations made by the Council are as follows:

(i) The Central Government should make available to the Indian Council of Agricultural Research an annual non-lapsable grant of Rs. 20 lakhs to be specifically utilised for agricultural and veterinary education ;

(ii) Steps should be taken to establish suitable institutions on a regional basis for agriculture and veterinary science ;

(iii) Rural universities should be started in suitable areas where there is possibility of developing existing agricultural college into universities by introduction of studies in allied branches likely to benefit life in rural areas ;

(iv) The library facilities in the various agricultural and veterinary colleges should be improved by making more funds available in the colleges for purchase of library books, appointment of trained librarians and keeping the libraries open at a time when the students are free from class-room studies ;

(v) In order that the students may be made to work regularly, credit should be given for day-to-day work assessed periodically by the instructors for purposes of the University examination ;

(vi) Special refresher course should be organised for the benefit of teaching staff members of veterinary colleges in order to keep them up-to-date with the latest developments in the field of veterinary science ;

(vii) It is desirable to encourage staff members in the agricultural and veterinary colleges to undertake research work in their special fields of study. For this purpose, the appointing authorities should consider the possibility of lessening the teaching load of staff members engaged in research work while fixing the strength of teaching staff in the colleges ;

(viii) The Indian Council of Agricultural Research should start a quarterly journal on agricultural education ;

(ix) Steps should be taken to publish suitable text-books for under-graduate students in agricultural and veterinary colleges on subjects for which such books are not available at present.

Due to lack of funds it has not been possible for the Government of India to accept the recommendation at (i) above. Necessary action with regard to recommendations Nos. (ii), (vi), (viii) and (ix) is being taken by the I.C.A.R. The remaining recommendations primarily concern the State Governments and Universities and have been communicated to them for suitable action.

CHAPTER VI

PUBLICATIONS AND PUBLICITY

Publications

Scientific journals: The Council's scientific journals, *viz.*, the "Indian Journal of Agricultural Science" and the "Indian Journal of Veterinary Science and Animal Husbandry" were published regularly.

Statistical Newsletter: This quarterly bulletin which reports the activities of the statistical wing of the Council and other items of interest to the statisticians was published regularly. Popular articles contributed by statisticians continued to be published, which contain useful information for agricultural workers. The bulletin was distributed widely both in India and abroad.

Horticultural Abstracts: This monthly periodical contains abstracts, summaries and extracts from various journals, annual reports, bulletins, circulars and books, etc., published in India and abroad on horticulture. The main object of the bulletin is to keep the research workers in the country informed of the latest developments in the sphere of horticultural research in India and abroad. The periodical was published regularly and its get-up has been improved.

Occasional publications: The following publications were published during the period under report:

I. *Scientific Bulletins:*

1. Plant Introduction Reporter-II by H. B. Singh
2. Catalogue of Indian insect pests. Part 28-Authribidae by R. N. Mathur
3. Studies on fats, oils and vanaspati by Kehar, Roy and Krishnan
4. Breeds of sheep in the Indian Union by H. K. Lai

II. *Research and Review Service:* The publications in this series contain useful information on agricultural and animal husbandry subjects on accomplished results of researches carried out in the country. The following were published during the year under report:

1. Ranikhet disease in poultry by C. Seetharaman
2. Wheat varieties by G. S. Murty
3. Dairying in India.

4. Utilization of some agricultural wastes by D. Narayanamurthi

5. Improvement of pulse crops in Bombay State by L. S. S. Kumar and V. M. Chavan

6. Principles of feeding farm animals by K. C. Sen and S. C. Roy

7. Adhesives from seed proteins and seed cakes by D. Narayanamurthi

8. Cultivation of medicinal plants in Jammu and Kashmir by I. C. Chopra, S. N. Sobti and K. L. Handa

Subsidies : The Council continued to give financial assistance to scientific societies which publish scientific journals with a view to promoting and disseminating scientific knowledge. This scheme has been of great help in the continuance of a number of science journals which would have otherwise ceased publication owing to financial difficulties.

Exchange of publications

The Council has established exchange relations with scientific institutions all over the world.

The Council received foreign journals, reports of other miscellaneous publications in exchange for its own publications. Exchange of publications is undertaken on an equitable basis. The literature received from abroad proved to be a valuable addition to the Council's Library and useful to the technical personnel.

Indian Farming : The Journal was published regularly. Further improvements as regards get-up and contents were made. New features were also introduced. A special 'Rice' number of the journal and a 'Fertilizer Supplement' were issued during the year.

Kheti : The Journal was issued regularly and some new features such as Plant Diseases Calendar, Cottage Industries Series, Kitchen gardens etc., were added to the Journal. A special number on 'Agricultural Implements' was issued during the year.

Rice News Teller : The Council's bi-lingual quarterly journal 'Rice News Teller' has been re-oriented with effect from its October, 1956 issue. A vast improvement has been brought about in its layout and the way of presentation of material. The journal is now issued in two separate editions—English and Hindi.

Farm bulletins

The following Farm Bulletins were issued :

ENGLISH	HINDI
1. The Chiku in India	1. Groundnut Cultivation in India
2. Bee-keeping for Beginners	2. Goat Keeping for Profit
3. Arecanut Cultivation in India	3. Cotton Cultivation in India
4. Oranges, Lemons and Limes in India	4. Manures and Manuring
5. Sheep and Wool in India	5. The Mango in India
6. Tapioca Cultivation in India	6. Potato Cultivation in India
7. The Ber in India	7. Tobacco Cultivation in India
8. Temperate Fruits in India	8. The Chiku in India
	9. Oranges, Lemons and Limes in India

Dharti-ke-lal : The Journal was issued regularly and some new features were also introduced. Copies were supplied to the Community Development Ministry for distribution to N.E.S. and C.D. Blocks.

Indian Horticulture : The Council started a new quarterly English Journal under the above title, devoted exclusively to horticulture, floriculture, etc.

Ad hoc *publications*

A publication entitled "Flowering Trees in India" by Dr. M. S. Randhawa, dealing with the beautiful flowering trees found all over India was brought out.

During the International Rice Commission Meeting held in November, 1956 a monograph entitled 'Rice in India' was published. The monograph deals with research, extension, technology and marketing of rice.

Central Film Library

The Film Library loaned out films to various agencies and a large number of prints were obtained from internal and foreign sources.

A photographic library has now been added to the Film Library.

Regional language editions of I.C.A.R. publications

With a view to disseminating agricultural information on a larger scale, the Council has undertaken the task of bringing out regional language editions of some of its important publications. A start has been made with the Farm Bulletin Series. The Farm

Bulletins are being translated into Tamil, Telugu, Marathi, Bengali, Punjabi and Urdu languages.

Farm News Releases

The Farm News Releases on farm practice were issued regularly every week. Farm News Releases issued during a particular period are now being published in booklet form under the title 'Tips for Better Farming' for the use of farmers and Village Level Workers.

Leaflets and pamphlets

The following leaflets and pamphlets on fertilizers were issued during 1956-57:

(i) Urea

(ii) Bone-meal

(iii) Ammonium Sulphate

(iv) Ammonium Sulphate Nitrate

(v) Superphosphate

(vi) Fertilizer application

Distribution of publications

The activities of the Council in respect of distribution and sale of publications in agriculture, animal husbandry and allied subjects increased considerably during the period under report. The number of copies of publications supplied to the N.E.S. and C.P. Blocks during the year was 5,40,131 as against 40,000 supplied during the previous year. The total sale during this period amounted to Rs. 1,89,778 as compared to Rs. 72,400 during 1955-56. There was also considerable improvement in the advertisement revenue, which rose to Rs. 1,12,438 from Rs. 67,584 during the last year.

Publicity

Agricultural information, production and training

The Indian Council of Agricultural Research has undertaken a vastly expanded programme of agricultural information, production and training during the Second Five Year Plan. This includes the production, on the Central level, of extension teaching aids for use by extension personnel and cultivators, and the training on a

regional level of the State personnel in the preparation, production, distribution and use of all adopted types of extension teaching aids and mass communication methods for rural India.

Central Film Unit

A co-operative Film Production Unit has been set up in the Indian Council of Agricultural Research for the production of agricultural instructional films. The production of these films will be financed by (a) grants from the Government of India, and (b) contributions from the participating States and Commodity Committees. The films under category (a) will be produced under a co-operative working arrangement with the Ministry of Information and Broadcasting. For the production of films under category (b) a Production Unit has been set up in the Council. For the production of films by this Unit, necessary equipment and raw films have been received through the T.C.M. under the Indo-American Aid Programme. A T.C.M. specialist has been assigned to the Council for advising on the production of films. Under this programme the Council's Film Unit will, besides producing films, also train the States' personnel in this line.

Supply of agricultural information literature to village level workers, etc.

To ensure that the village level workers and the supervisory staff of the National Extension Blocks are constantly fed with agricultural information essentially needed to keep them abreast of day-to-day developments in the field of agriculture, animal husbandry and allied subjects, the Council has initiated a scheme for supply of agricultural information literature to village level workers etc. as a part of the Second Five Year Plan. Under this scheme, the Council has started supply to the National Extension Service Blocks of leaflets and pamphlets and Farm Bulletins, which contain tested results relating to agricultural and animal husbandry practices considered useful for farmers. These publications are at present being supplied to them in the two languages in which they are printed, *viz.*, English and Hindi. Arrangements have, however, been made to get them translated in the regional languages so as to enable the village level workers to derive full benefit from these publications.

T.C. M. assistance for agricultural information programme

For the effective use of the printing units procured under the Indo-U.S. Technical Co-operation Programme during 1954-55 and supplied to the various States for the production of agricultural information literature and visual aids, further supplies of multi-lith and photographic materials worth about $1,25,000 were obtained through the T. C. M. and distributed to the States.

Agricultural information workshops

The Council continued to organise agricultural information workshops in the States for training States personnel in the art of preparation and utilization of the agricultural information materials.

Exhibitions

The year 1956-57 was the second year of the operation of the Exhibition Scheme. It was started in the year 1955-56 under the Five Year Plan. It aims at popularising improved farming practices in the villages through the effective method of organising exhibitions. In India, where 90 per cent of the farmers cannot read and write, exhibitions play an important role in the task of improving agricultural practices and increasing the food yield. The fact that exhibitions can bring home scientific facts to the masses more easily and effectively than the printed or spoken word, has been proved in all the advanced countries of the world. Farmers in India have evinced great interest in the Council's exhibitions.

Though organising exhibitions is one of its recent activities, the Council received several invitations from India and abroad for organising and participating in agricultural exhibitions during the year. Foreign invitations were declined in view of the stringent foreign exchange position and also due to our pre-occupations at home.

The Council had to decline several invitations from the States also, for want of time and staff.

The Council participated in the following three Exhibitions during the year 1956-57:

1. *Khadi and Village Industries Exhibition:* The Exhibition was organised in conjunction with the All-India Congress Session from the 2nd to 13th January, 1957, at Indore. It was visited by about one lakh farmers.

2. *Exhibition organised by the All-India Cattle Show Committee in the All-India Show from the 2nd to 9th January,* 1957, *at Indore:* This Exhibition emphasised the better animal husbandry and dairy practices for the benefit of farmers. It was visited by about one lakh farmers.

3. *Agricultural Exhibition organised by the Farmers' Forum, India, at New Delhi from the 20th to 25th March,* 1957: Farmers from all parts of India had gathered to attend the Convention of the Forum at Talkatora Gardens, New Delhi. The Council put up exhibits to high-light the advantages of green manuring, reclamation of land, raising chickens, proper management of cattle and growing citrus varieties.

To re-inforce the technical information contained in the exhibits, the Council also arranged to distribute one-page circulars on improved farming practices and sell leaflets, bulletins and magazines in the stalls.

CHAPTER VII

LIBRARY

The main activities of the Library comprise work done under the following heads: (1) Acquisition Section (2) Service Section (3) Reorganisation of the Library and (4) Library Statistics.

1. *Acquisition Section*

The number of publications added during the year was 1,140. These have been classified and catalogued. Seven library lists of additions were prepared and circulated to officers. These covered a total of 452 entries. The number of catalogue cards prepared is more than 2,500.

About 825 sets of periodicals were received in the Library. Of these, about 120 were subscribed for, and the rest mostly received on exchange basis, while a few were received on complementary basis.

Current issues of periodicals numbering 6,326 and newspapers numbering 5,606 were received and registered; 635 volumes were got bound—most of these were periodicals.

2. *Service Section (Circulation)*

Selected issues of periodicals numbering approximately 5,000 were displayed in the reading-room periodical racks and about 700 were circulated to advisers and other officers.

Loan: There has been a considerable increase in loan service. Total number of loan transactions during the year was 3,718 including the Branch Library (Statistical Wing) as against 2,050 during the previous year.

Consultation: The use of the library has increased considerably. The readers' register has recorded the visit of 4.148 readers during the year. About 10,500 publications were consulted by them.

Bibliographic Service: Besides large numbers of routine questions, 19 long-range reference questions were handled at the Library. These involved searches and compilation of 19 bibliographies on a number of subjects, covering a total of 441 references and 71 typed pages.

Besides the officers of the Council, I.A.R.I., and Ministries of the Union Government at Delhi, the reference service was extended to (1) the Embassy of Belgium in India, (2) the University College

of Science, Calcutta, (3) Professor, Department of Botany, Presidency College, Calcutta, (4) Shri E. S. Harvey, "Whitehall", Negril, Jamaica, B.W.I., (5) Chemist, Koocha Tainiwala, Amritstar, (6) Research Assistant, Allahabad Agricultural Institute, (7) Commercial and Agricultural Attachee, Embassy of France in India, (8) Raze Sugar and Co. Ltd., (9) Lt. Gen. J. N. Choudhury, (10) Lt. Governor Shri Bajrang Bahadur Singh Bhadri, (11) Agriculture, Forestry and Fisheries Productivity Conferences, Japan. The reference service was improved considerably and maintained at a high level.

Press cutting service : About 1,000 press cuttings were prepared during the year. Of these about 730 were circulated to advisers and experts of the Council.

3. *Reorganisation of the library*

Dr. Ralph Robert Shaw, Professor of Library Science, Rutgers University, New Jersey, U.S.A., was invited by the Council to study various agricultural and veterinary college and research institute libraries in India and formulate recommendations for their improvement to adequately support agricultural and veterinary research and education in India. Dr. Shaw came in the last week of December, 1956, and toured the country for about three weeks and submitted his report to the Council. Some of the recommendations in the report are being implemented and the rest are still under consideration.

Organisation of a branch library at Statistical Wing : The Branch Library at the Statistical Wing is for immediate service to the officers and students in the Statistical Wing. To improve the collection for efficient service, it was decided to purchase duplicate sets of books and periodicals specially wanted there and those which cannot be spared from the Main Library. Efforts are well in progress to make the collection at the Branch Library, as far as possible, representative of all the subjects. About 150 publications of the Branch Library were bound.

4. *Library-statistics*

Books and publications added	1,140
Current periodical issues received	6,326
Newspapers received	5,605
Press cutting service	1,000
Number of loan transactions	3,718
Consultation service	10,500
Number of publications classified	368
Number of catalogue cards	More than 2,500
Number of readers	4,148

APPENDIX I

List of meetings held during the year 1956-57

1.	Meetings of the Local Sub-Committee of the Standing Committee	2
2.	Meetings of the Regional Committees	5
3.	Meetings of the Scientific and Commodity Committees	57
4.	Meetings of the *Ad hoc* Committees & Sub-Committees	11
5.	Symposium on Citrus	1
6.	Meetings of the Working Parties on Agriculture and Animal Husbandry	2
7.	Joint Meeting of the Boards of Research & Extension	1
8.	Meeting of the Advisory Board	1
9.	Meeting of the Standing Finance Committee	2
10.	Meeting of the Standing Committee	1
11.	Meeting of the Governing Body	1
12.	Annual General Meeting	1
13.	Special General Meeting	1
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APPENDIX II

Schemes, the continuation of which was sanctioned by the Governing Body.

1. Physiology of flowering in tropics, Calcutta University.
2. Breeding rice resistant to *Piricularia*, Andhra.
3. Storage & Viability of Pollen Grains, Delhi University.
4. Additional staff for rice breeding scheme, Madhya Pradesh.
5. Paddy Agromyzid fly, Hyderabad.
6. Blast disease of rice and foot rot wheat, Bombay State.
7. Multiplication and distribution of hybrid bajra seeds, Madras.
8. Banana Research Station, Madras.
9. Research on Cashewnut, Kerala.
10. Fruit Research Scheme, Orissa.
11. Coordinated Scheme for preservation and storage of fruits and vegetables by the use of hormones and chemicals. C. F. T. R. I., Mysore and Kulu (Punjab).
12. Citrus Fruit Research Scheme, Tharsa (Bombay).
13. Scheme for devising control measures for serious diseases of Guava, Ajmer.
14. Tuber crops, Bihar.
15. Combined scheme for research on tapioca and sweet potato, Travancore-Cochin (Kerala State).
16. Chillies improvement scheme, Andhra.
17. Zira research scheme, Rajasthan.
18. Medicinal plants scheme, Forests Research Institute, Dehradun.
19. Medicinal plants scheme, Assam.
20. Ergot research scheme, West Bengal.
21. Scheme for research on pests and diseases affecting cashewnut plantations in Madras.
22. Scheme for production, demonstration and trial of agricultural implements, I.A.R.I.
23. Scheme for study of humification of organic matter in relation to the physico-chemical properties of soils, Agra College.
24. Scheme for the standardisation of methods of soil analysis, Field Research Station, Bombay.

25. Scheme for investigation into the micro-nutrients of the soils of Bombay.

26. Scheme for research on the application of ammonium sulphate to paddy lands, West Bengal.

27. Purchase of four Jersey bulls for the Central A. I. Station, Bangalore.

28. Crossbreeding of cattle in hilly and heavy rainfall areas—Unit in Darjeeling District of West Bengal.

29. Expansion of CHG Scheme, I. C. A. R.

30. Wool Analysis Laboratory, Gaya (Bihar).

31. Sheep and Wool Improvement on regional basis, Bihar.

32. Sheep and Wool Improvement on regional basis, Uttar Pradesh.

33. Sheep and Wool Improvement on regional basis, Bombay.

34. Indigenous Goat breeding Scheme, Punjab.

35. Egg laying trials—I.V.R.I.

36. Scheme for commercial chick hatchery—Agri. Instt., Katpadi.

37. Scheme to supplement livestock investigation, Punjab.

38. Evolving a suitable draught capacity standard for bullocks—I. V. R. I.

39. Research on the manufacture of "Fat-liquors" from indigenous raw materials for leather production from Indian hides and skin, C. L. R. I., Madras.

40. Research on the manufacture of chrome retan leather from cow hides for military purposes—C. L. R. I. Madras.

41. Research on the manufacture of leather boards from leather shavings which are waste products of tanneries—C. L. R. I., Madras.

42. Improvement of quality of shoe upper and industrial leather manufactured by mineral tanning—C. L. R. I., Madras.

43. Investigations on the causes of degeneration of cattle in humid climates—I. V. A. R.

44. Utilisation of waste products as cattle feed—Orissa.

45. Further work on paddy straw—I. V. R. I.

46. Study of the value of urea as a protein substitute in the rations of cows and buffaloes for growth and milk production.

47. Provision of jeeps and additional equipment to each of the Regional Animal Nutrition Research Stations.

48. Investigations on the causes of degeneration of cattle in humid climate.

49. Disease Investigation Officers Scheme—Travancore-Cochin.

50. Humpsore Scheme—Orissa.
51. A. D. I. O. (Sheep and Goats), U.P.
52. Bovine contagious pleuro-pneumonja, Assam.
53. Investigation on processing inedible unpopular fish caught in West Bengal.
54. Scheme for running refresher courses in agriculture for young farmers at the Agriculture College, Coimbatore, Madras.
55. Supply of Agricultural Information Literature to N. E. S. Blocks.
56. Publication of a monthly Hindi journal "Kheti".
57. Bringing out publications of I. C. A. R. in regional languages.
58. Publication of crop calendars, crop diaries, charts of plants diseases, etc.
59. Additions to the I. C. A. R. Statistical Wing Building.
60. Award of fellowships to I. C. A. R. Diploma students in agricultural statistics.
61. Additional posts of two typists in the Publicity Scheme.

APPENDIX III

New schemes sanctioned

1. Induction and study of amphiploidy in rice, Presidency College, Calcutta.
2. Improvement of hill paddy.
3. Investigation of deep-water paddy.
4. Investigation on Boro paddy.
5. Cytological studies on maize.
6. Drought resistance in wheat.
7. Co-ordinated Maize Breeding Scheme.
8. Pulse research scheme, Assam.
9. Improvement of pulses, Andhra.
10. Investigation on cytogenetics and morphogenesis of nodules of common Indian leguminous crops, West Bengal.
11. Cytogenetics of the wild grasses and breeding them for selection of fodder and forage grasses, Madras.
12. Cultural studies with upland paddy, West Bengal.
13. Chemical investigations of the cause of blast resistance in paddy, Madras.
14. Wilt diseases of maize, Bihar.
15. Projects for Crop Production and Development—Distribution of hybrid maize seeds, I. C. A. R.
16. Wheat Research Workers' Conference 1956—Allotment of funds, I. C. A. R.
17. Cytogenetical and physiological studies in relation to floriculture, I. A. R. I.
18. Cultivation of lotus, U.P.
19. Research and development of floriculture, Punjab (PEPSU).
20. Banana Research Station, Andhra.
21. Cytogenetical studies on grapes and related wild species, Madras.
22. Improvement of pine-apple by application of growth regulating substances, Gauhati University, Assam.
23. Scheme for investigation of root-rot, limb breakage deficiency diseases in citrus, Andhra.
24. Training in fruit preservation, Andhra.
25. Twig-blight diseases of orange, West Bengal.

26. Research on pine-apples, West Bengal.
27. Proposal for obtaining an Italian Expert on Horticulture, I. C. A. R.
28. Onion Research Scheme, Andhra.
29. Improvement of root crops, West Bengal.
30. Improvement of onion and garlic, West Bengal.
31. Pan Research Scheme, Uttar Pradesh.
32. Pan Research Scheme, Madras.
33. Pan Research Scheme, Madhya Pradesh.
34. Scheme for the improvement of lemon grass, Kerala State (T. Cochin).
35. Scheme for research on pepper and cardamon, Orissa.
36. Scheme for the improvement of spices, Delhi University.
37. Study of the rate of decomposition of insecticidal deposits, Osmania University, Hyderabad—Dn.
38. Building up the named reference collections of insect pests, Andhra Pradesh.
39. Studies on the Aphidae, West Bengal.
40. Toxicology and adverse effects of synthetic pesticides, Madras.
41. Fundamental research on the toxicity and mode of action of insecticides, Punjab University.
42. Bio-assay and other techniques in the study of plant diseases, Madras University.
43. Research on fungicides, I. A. R. I.
44. Increase in yield of fruits and vegetables by bee-pollination, Bombay.
45. Establishment of Vegetables Station, Andhra.
46. Research on cashewnut (Revival of the Scheme), Bombay.
47. Orange Research Scheme (Additional grant), Coorg.
48. Spices and cashewnut show, I. C. A. R.
49. Green Manure, Uttar Pradesh Government.
50. Studies in the cost of reclamation of *Kalar* (Alkali) Lands, Khalsa College, Amritsar.
51. Nature and extent of intake of different forms of phosphate by leguminous green manure crops and their availability to paddy, Madras.
52. Scheme on the possibility of using carbons in improvement and reclamation of soils, Punjab University.

53. Scheme for standardisation of methods for determining (i) surface areas, and (ii) pH values of soils, Dr. P. R. Pruthi, Punjab University.

54. Scheme for research on demineralisation of water, Government of Punjab, Ludhiana.

55. Scheme for the studies of fertility index of soils and related phenomena leading to prediction of equation of crop production, Field Research Station, Bombay.

56. Scheme for the investigation of *Khar* lands in Bombay State, Sholapur (Bombay).

57. Scheme for the reclamation of saline soils, West Bengal.

58. Biological approach for the reclamation of saline and alkaline soils, West Bengal.

59. Foliar application of nutrients to crops, I. A. R. I.

60. Soil structure of Punjab, Punjab.

61. Nitrogen fixation of leguminous crops, Madras.

62. Scheme for salinity and alkalinity control in the Punjab soils, Irrigation and Power Research Institute, Amritsar.

63. Investigation on the progeny testing of bulls under Indian conditions, Co-ordinated Scheme (2 units).

64. Determination of the age of maturity in Indian bulls, Orissa.

65. Evolution of a new breed of dairy cattle by crossing Hariana Cows with Jersey bulls, Milk Commissioner, West Bengal.

66. Cross breeding of local non-descript cattle, Andhra Government.

67. Cattle sterility (Five centres).

68. Physiology of humps, dewlap and sheath, Government of West Bengal.

69. Progeny testing of Murrah Bulls, Bombay Government.

70. Definition of the ideal animals, I. C. A. R.

71. Development of mutton breeds of sheep, Madras.

72. Wool utilisation centre, Madras.

73. Skin studies of sheep, I. C. A. R. (3 units).

74. Influence of the system of rearing on the sex behaviour of breeding bulls, Co-ordinated scheme, I. C. A. R. (6 units).

75. Exploring the possibilities of mohair production, Animal Husbandry, Andhra.

76. Defertilisation of eggs—Follow-up work, I. V. R. I., Ministry of Food and Agriculture.

77. Studies on the growth rate and egg production of purebred *versus* crossbred poultry when fed on two different diets, Milk Commissioner, West Bengal.

78. Correlation between physical body characteristics and egg production, Ministry of Food and Agriculture.

79. Estimation of milk sucked by calves in unweaned herds, Institute of Agriculture, Anand.

80. Thickness of skin and distribution of sweat glands of buffaloes in relation to milk production, I. V. R. I., Ministry of Agriculture.

81. Relative value of selective breeding *vs.* grading up of Umblacherry Cattle, Madras.

82. Comparative value of grading up with Sindhi and cross breeding with Jersey, Kerala.

83. Establishment of a camel farm for the Bikaneri Breed and opening of ten key village Centres for the improvement of camel in Rajasthan, I. C. A. R./Rajasthan.

84. Diploma Course in swine husbandry and pork production, Uttar Pradesh Government, Uttar Pradesh.

85. Evolving a new type of pig by cross-breeding—Uttar Pradesh Government, Uttar Pradesh.

86. Survey of bacteriological quality of milk supply in Allahabad, U. P.—Allahabad Agricultural Institute.

87. Survey of bacteriological quality of milk supply in Andhra —Andhra Pradesh.

88. Possibility of spreading out the breeding season of buffaloes —I. V. R. I., Ministry of Agriculture.

89. Co-ordination of research on creation of a co-ordinating unit—I. C. A. R.

90. Determination of economic poultry rations, Andhra Pradesh and Punjab—Director of Animal Husbandry, Andhra, Government of Madras and Government of Punjab.

91. Investigation of the toxic plants and herbs lethal to domestic animals, West Bengal—West Bengal Government.

92. Investigation on the nutritional requirements of pigs—I. V. R. I., Government of India, Ministry of Agriculture.

93. Investigation on the quality of wool and meat in relation to the nutrition of sheep—Balwant Rajput College, Agra, Uttar Pradesh Government.

94. Provision of one A. R. O., one Statistical Assistant and one stenographer for the Co-ordinating Officer (Animal Nutrition).

95. Studies on the life-history and bionomics of *Erytrema* etc. West Bengal—Director, Animal Husbandry and Veterinary Services.

96. Studies on Microtic diseases, West Bengal—West Bengal Government.

97. Scheme for elucidation of life-history of (1) *Parafilria bevicola* (2) *Setaria Ceriei, and* (3) *Setaria digitata*, including studies on their pathogeneicity and therapeutics, Bihar—Government of Bihar.

98. Investigation of brucellosis, Bihar—Director, Animal Husbandry, Bihar.

99. Scheme for investigation of suitable methods for the control of ascariasis in calves, Andhra Pradesh—Director of Animal Husbandry, Andhra State.

100. Investigation of the possibilities of large-scale manufacture of H. S. vaccine, Director, I. V. R. I.

101. Keeping-quality of veterinary biological products, Director, I. V. R. I.

102. Scheme on experimental study of bovine anaesthesia—Director, Animal Husbandry and Veterinary Services, Orissa.

103. Investigation of the use of sterilizers in Rinderpest and Ranikhet disease vaccine—Director, Animal Husbandry, Uttar Pradesh.

104. Scheme for study of microbial flora associated with freshwater fish in West Bengal as well as with the estuarine and deep-sea fish from the Bay of Bengal—Government of West Bengal.

105. Setting up a Central Stores Organisation in the I.C.A.R.

106. Publication of a quarterly popular journal 'Indian Horticulture', I. C. A. R.

107. Publication of a monograph entitled 'Rice in India', I. C. A. R.

108. Publication of a monograph entitled 'Mango', I. C. A. R.

109. Publication of a monograph entitled 'Poultry', I. C. A. R.

110. Preparation of a monograph on algae, Headquarters Scheme.

111. Preparation of monograph on different groups of fungi and the disease of various crops, Headquarters Scheme.

112. Preparation of Monograph on 'Agricultural Meteorology', Headquarters Scheme.

113. Scheme for revision of the monograph on potatoes, Headquarters Scheme.

114. Reprinting of the hand-book "Statistical Methods for Agricultural Workers", Headquarters Scheme.

115. Translation into Spanish language of the book "Statistical Methods for Agricultural Works", Headsuarters Scheme.

116. Publication of a quarterly journal of Agricultural Education, Headquarters Scheme.
117. Free supply of I. C. A. R. publications to the various agricultural and veterinary colleges in India, Headquarters Scheme.
118. Study of mechanised farming, Banaras Hindu University.
119. Survey of Farm and Non-Farm Employment in South Arcot District, Annamalai University.
120. Enquiry into factors influencing cropping patterns on individual farms, I. C. A. R.
121. Scheme for further investigation on the technique of sampling of fleeces for assessing wool quality, I. C. A. R.
122. Requisition of the services of Japanese expert to survey the possible sites for laying gardens on the Japanese style, I. C. A. R.

APPENDIX IV

Schemes which terminated during 1956-57

1. Barley improvement, Rajasthan.
2. Nutritive value of wheat, I. A. R. I.
3. Chemical composition and nutritive value of fruit and vegetables, Coonoor.
4. Co-ordinated scheme on the effect of chemicals on the storage of fruits and vegetables, Uttar Pradesh.
5. Co-ordinated scheme on the effect of chemicals on the storage of fruits and vegetables, Bombay.
6. Co-ordinated scheme on the effect of chemicals on the storage of fruits and vegetables, Madhya Pradesh.
7. Tuber crops, Andhra.
8. Azotobacter inoculations of crops, West Bengal.
9. Nitrogen fixation, Madhya Pradesh.
10. Dry farming and soil conservation, Bhopal.
11. Phenological observations, Poona.
12. Studies on overhead irrigation, Bombay.
13. Tests with D. D. T. and allied insecticides, Bombay.
14. Termite Research, Anand.
15. Pre-soaking seeds in nutrient salts, Madras.
16. Survey of agricultural practices, I. C. A. R.
17. Soil analysis for Sheep Breeding, Jammu and Kashmir, I. A. R. I.
18. Preparation of a compendium on animal nutrition investigation, West Bengal,
19. Cost of milk production, I. C. A. R.
20. Training Course in livestock marketing, A. M. A. G. Office.
21. Survey of camel breeding, I. C. A. R.
22. Refresher course in agriculture for young farmers, Andhra.
23. Refresher course in agriculture for young farmers, Hyderabad.
24. Survey of indigenous implements, Uttar Pradesh.
25. Survey of indigenous implements, Punjab.
26. Survey of indigenous implements, Orissa.
27. Survey of indigenous implements, Mysore.
28. Survey of indigenous implements, Rajasthan.
29. Survey of indigenous implements, I. C. A. R.
30. Cost of production of Sheep and Wool, Poona.
31. Development of Cashewnut, Madhya Bharat.
32. Survey of pepper, I. C. A. R.
33. Mass immunisation against Ranikhet disease, Bombay.
34. Improvement in craft and tackle for inland and estuarine fishing, Orissa.
35. Vaccination of goats against contagious caprine pleuropneumonia, I. V. R. I.

APPENDIX V

Indian Council of Agricultural Research Society

1. Shri Ajit Prasad Jain, Minister for Food and Agriculture, Government of India, New Delhi.
2. Dr. M. S. Randhawa, I.C.S., Vice-President, Indian Council of Agricultural Research, New Delhi.
3. Shri P. Thimma Reddy, Minister for Local Administration and Agriculture, Government of Andhra Pradesh, Hyderabad Deccan.
4. Shri Ram Nath Das, Minister in charge of Agriculture and Food, Government of Assam, Shillong.
5. Dr. Anugraha Narain Sinha, Minister in charge of Agriculture and Fisheries, Government of Bihar, Patna.
6. Shri Mustafa G. Kaki, Minister in charge of Agriculture and Forests, Government of Bombay, Bombay.
7. Shri Takhat Mal Jain, Minister in charge of Agriculture, Government of Madhya Pradesh, Bhopal.
8. Shri M. Bhaktavatsalam, Minister in charge of Agriculture, Government of Madras.
9. Shri H. S. Rudrappa, Minister in charge of Agriculture, Government of Mysore, Bangalore.
10. Shri Radha Nath Rath, Minister in charge of Agriculture, Animal Husbandry, Forestry and Fisheries, Government of Orissa, Bhubaneswar.
11. Sardar Gurbanta Singh, Development Minister in charge of Agriculture, Government of Punjab, Chandigarh.
12. Shri Ram Niwas Nirdha, Minister in charge of Agriculture, Government of Rajasthan, Jaipur.
13. Thakur Hukam Singh, Minister in charge of Agriculture, Government of Uttar Pradesh, Lucknow.
14. Dr. A. Ahmed, Minister in charge of Agriculture and Co-operation, Government of West Bengal, Calcutta.
15. Syed Mir Qasim, Revenue Minister in charge of Agriculture, Government of Jammu & Kashmir, Srinagar/Jammu Tawi.
16. Shri A. D. Pandit, I.C.S., Chief Commissioner of Delhi, Delhi.
17. Shri Bajrang Bahadur Singh, Lt.-Governor of Himachal Pradesh, Simla.
18. Shri P. C. Mathew, I.C.S., Chief Commissioner of Manipur, Imphal.
19. Shri K. P. Bhargava, I.C.S., Chief Commissioner of Tripura, Agartala.

20. Shri T. G. N. Ayyar, I.C.S., Chief Commissioner, Andaman and Nicobar Islands, Port Blair.
21. Shri S. Moni, Administrator, Laccadive, Minicoy and Amindive, Kozhikode-5.
22. Shri I. J. Naidu, I.A.S., Director of Agriculture, Andhra Pradesh, Hyderabad-Deccan.
23. Shri L. K. Handique, Director of Agriculture, Assam, Shillong.
24. Shri B. P. Akhaurry, Director of Agriculture, Bihar, Patna.
25. Dr. T. G. Shirname, Director of Agriculture, Bombay State, Poona.
26. Shri P. D. Nair, Director of Agriculture, Kerala State, Trivandrum.
27. Shri R. C. Murab, Director of Agriculture, Animal Husbandry and Veterinary Services, Madhya Pradesh, Rewa.
28. Shri E. U. Damodaran, I.A.S., Director of Agriculture, Kerala State, Trivandrum.
29. Shri M. Mallaraj Urs, Director of Agriculture, Mysore State, Bangalore.
30. Shri G. C. Dash, Director of Agriculture, Food Production, Orissa, Cuttack.
31. Dr. Arjan Singh, Director of Agriculture, Punjab, Chandigarh.
32. Shri Samrath Raj, Director of Agriculture and Food Production, Rajasthan, Jaipur.
33. Shri Ram Surat Singh, Director of Agriculture, Uttar Pradesh, Lucknow.
34. Dr. H. K. Nandi, Director of Agriculture, West Bengal, Calcutta.
35. Shri G. M. Butt, Director of Agriculture, Jammu and Kashmir, Srinagar, Jammu Tawi.
36. Shri N. Bhagwandas, I.A.S., Director of Animal Husbandry, Andhra Pradesh, Hyderabad-Deccan.
37. Shri S. M. L. Bhatnagar I.A.S., Director of Veterinary Services and Animal Husbandry, Assam, Gauhati.
38. Shri S. K. Sen, Director of Animal Husbandry, Bihar, Patna.
39. Shri S. R. Chadha, Director of Veterinary Services, Bombay State, Poona.
40. Shri V. K. Madhava Menon, Director of Animal Husbandry, Kerala State, Trivandrum.
41. Shri D. Pattabiraman, Director of Animal Husbandry, Madras State, Madras.
42. Shri Gurbachan Singh, Director of Veterinary Services and Animal Husbandry, Orissa, Cuttack.
43. Shri K. S. Shetty, Director of Animal Husbandry and Veterinary Services, Mysore State, Bangalore.
44. Shri R. R. Gulati, Director of Veterinary Services and Chief Warden of Fisheries, Punjab, Simla.

45. Dr. P. G. Pande, Director of Animal Husbandry, Uttar Pradesh, Lucknow.
46. Dr. S. Dutta, Director of Veterinary Services, West Bengal, Calcutta.
47. Shri V. L. Wazir, Director of Veterinary Services, Jammu and Kashmir, Srinagar/Jammu Tawi.
48. Shri P. N. Thapar, I.C.S., Secretary to the Government of India, Ministry of Agriculture, New Delhi.
49. Shri Beni Prasad Aggarwal, Member, Rajya Sabha, 119—A, Mukta Ram Babu Street, Calcutta—7./11—C, South Avenue, New Delhi.
50. Shri K. Madhava Menon, Member, Rajya Sabha, "Padmalayani" Kozhikode, Malabar./26 Mandi House, New Delhi.
51. Shri K. G. Deshmukh, Member, Lok Sabha, Namuna Amravati, Bombay State./177—B North Avenue, New Delhi.
52. Shri Algu Rai Shashtri, Member, Lok Sabha, Amila Town District, Azamgarh, Uttar Pradesh./15, Canning Lane, New Delhi.
53. Shri Sakhtivadivel Gounder, Member, Lok Sabha, Kamayakkavandanpatti P.O., District Madurai, Madras State.
54. Shri Jhulan Singh, Member, Lok Sabha. Hajiapur, P.O. Gopalgunj, District Saran, Bihar./27—B, North Avenue. New Delhi.
55. Shri Ratilal M. Gandhi, C/o Ratilal and Co., Currimjee Building, 111, Mahatma Gandhi Road, Bombay-1.
56. Shri A. R. Foster, C/o M/s. Imperial Chemical Industries (India) Private Ltd., P. O. Box No. 107, New Delhi.
57. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi.
58. Animal Husbandry Commissioner with the Government of India, New Delhi.
59. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi.
60. Dr. M. R. Ghatge, Agricultural Marketing Adviser to the Government of India, New Delhi.
61. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.
62. Shri Laxmi Sahai, Director, Indian Veterinary Research Institute Izatnagar.
63. Dr. S. Bhagwantam, Director, Indian Institute of Science, Bangalore.
64. Shri K. L. M. Ghose, Director, Central Rice Research Institute, Cuttack.
65 Dr. Pushkar Nath, Director, Central Potato Research Institute, Simla.
66. Shri K. L. Aggarwal, I.F.S., President, Forest Research Institute and Colleges, P. O. New Forest, Dehra Dun.
67. Dr. M. D. Patel, Director, Institute of Agriculture, Anand.
68. Dr. K. C. Sen, Director, National Dairy Research Institute, Karnal.

69. Shri Thakur Das Bhargava, Member, Lok Sabha, Anand Bhavan, Hissar./30 Canning Lane, New Delhi.
70. The Secretary, Central Board of Forestry, Ministry of Agriculture, Government of India, New Delhi.
71. Shri M. S. Thacker, Director-General, Council of Scientific and Industrial Research, New Delhi.
72. Shrimati Lilavati Munshi, Bharatiya Vidya Bhavan, Chowpatty Road, /20, Northern Bombay,/Court, New Delhi.
73. Shri G. G. Takle, Inspector General of Forests, Ministry of Agriculture, Government of India, New Delhi.
74. Dr. C. G. Pandit, Director, Indian Council of Medical Research, New Delhi.
75. Dr. Radha Kamal Mukherjee, Vice-Chancellor, Lucknow University, Lucknow.
76. Shri K. P. Bhatnagar, Vice-Chancellor, Agra University, Agra.
77. Shri V. S. Krishna, Vice-Chancellor, Andhra University, Waltair.
78. Dewan Anand Kumar, Vice-Chancellor, Punjab University, Chandigarh.
79. Shri H. Ferguson, Director, Scientific Department, Indian Tea Association, P. O. Cinnamara, Assam.
80. Shri K. H. Srinivasan, Kebetta Estate, Somwarpet P. O. North Coorg, Mysore State.
81. Shri T. A. Jacob, Kaithayil House, Mangam, Kottayyam, Kerala State.
82. Shri B. L. Sethi, Secretary, Indian Central Cotton Committee, 14, Nicol Road, Ballard Estate, Bombay-1.
83. Shri B. K. Das, Member, Lok Sabha, P. O. Contai, District Midnapore, West Bengal,/7—Electric Lane, New Delhi.
84. Shri B. L. Singh, C/o M/s. Bhagirath Ram & Sons, 14, Bentinck Street, Calcutta.
85. Shri C. Bali Reddy, Secretary, Andhra Provincial Kisan Sammelan, Cumbum, District Kurnool.
86. Shri P. Balarama Kurup, Technochemical Industries, P.O. Box No. 74, Kozhikode, Malabar District.
87. Shri Mohanlal Ambalal Parikh, C/o Messrs. Mohanlal Hargovinddas, 51, Dadyseth Agiary Lane, Bombay-2.
88. Shri G. U. Rao, 54, Kondappa Chetty Street, G. T., Madras-1.
89. Shri C. T. Ithachin, B.Sc. Ag., Proprietor, Kootanad South Estate, Kootanad, South Malabar, Kerala State.
90. The Director of Remounts, Veterinary and Farms, Quarter-Master General's Branch, Army Headquarters, New Delhi.
91. Shri Chimalal B. Parikh, Vice-President, Indian Central Cotton Committee, 28, Apollo Street, Fort, Bombay.
92. Shri T. G. Walton, Vice-President, Indian Central Jute Committee, C/o Thomas Daft & Co. (India) Ltd., Cline Road, Calcutta.

93. Sardar Lal Singh, Member, Lok Sabha, Village & P. O. Nandpur, District Ludhiana,/70—C, North Avenue,/New Delhi.
94. Shri K. P. Madhavan Nair, Member, Rajya Sabha, Vice-President, Indian Central Coconut Committee, Ernakulam Mills Buildings, Ernakulam/26, Queen Victoria Road, New Delhi.
95. Shri Kotha Raghuramiah, Member, Lok Sabha, Harrington Road, Chetpet, Madras.
96. Shri Ratilal M. Gandhi, Ratilal & Co., Currimjee Building, 111, Mahatma Gandhi Road, Bombay-1.
97. Shri A. M. Thomas, Advocate, Member, Lok Sabha, Vice-President, Indian Central Arecanut Committee, Ernakulam.
98. Dr. S. K. Sen, Economic and Statistical Adviser, Ministry of Agriculture, Government of India, New Delhi.
99. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi.
100. Dr. D. Bhatia, Fisheries Development Adviser to the Government of India, Ministry of Agriculture, New Delhi.
101. Shri K. L. Ghei, Joint Secretary to the Government of India, Ministry of Finance (Food & Agriculture Division) and Financial Adviser, Indian Council of Agricultural Research, New Delhi.
102. Shri O. P. Ramaswamy Reddiar, MLC., Suha Sanmargha Nilayam, Vadalur, Vadalur, P. O., *via* Cuddalore Junction, South Arcot District.
103. Shri J. Raghotam Reddy, 173, Fateh Maidan, North Road, Hyderabad.
104. Shri Sri Kanth Kaul, C/o Parkash Seed Farm, Srinagar.
105. Shri K. P. Amrit Natha Iyer, Kottarathu, Madhom, Moncompu, Kerala State.
106. Shri M. P. Gandhi, C/o Gandhi & Co., Pheroz Shah Mehta Road, Fort, Bombay.

APPENDIX VI

Governing Body

1. Shri A. P. Jain, Minister for Food and Agriculture, Government of India, New Delhi.
2. Dr. M. S. Randhawa, I.C.S., Vice-President, Indian Council of Agricultural Research, New Delhi.
3. Shri M. V. Krishnappa, Deputy Minister for Food and Agriculture, Government of India, New Delhi.
4. Shri P. Thimma Reddy, Minister for Local Administration and Agriculture, Government of Andhra Pradesh, Hyderabad—Dn.
5. Shri Ram Nath Das, Minister in charge of Agriculture and Food, Government of Assam, Shillong.
6. Dr. Anugraha Narain Sinha, Minister in charge of Agriculture and Fisheries, Government of Bihar, Patna.
7. Shri Mustafa G. Faqi, Minister in charge of Agriculture and Forests, Government of Bombay, Bombay.
8. Shri Takhat Mal Jain, Minister in charge of Agriculture, Government of Madhya Pradesh, Bhopal.
9. Shri M. Bhaktavatsalam, Minister in charge of Agriculture, Government of Madras, Madras.
10. Shri H. S. Rudrappa, Minister in charge of Agriculture, Government of Mysore, Bangalore.
11. Shri Radha Nath Rath, Minister in charge of Agriculture, Animal Husbandry, Forestry and Fisheries, Government of Orissa, Bhubaneshwar.
12. Sardar Gurbanta Singh, Development Minister in charge of Agriculture, Government of Punjab, Chandigarh.
13. Shri Ram Niwas Mirdha, Minister in charge of Agriculture, Government of Rajasthan, Jaipur.
14. Thakur Hukam Singh Visen, Minister in charge of Agriculture, Government of Uttar Pradesh, Lucknow.
15. Dr. R. Ahmed, Minister in charge of Agriculture, and Cooperation, Government of West Bengal, Calcutta.
16. Syed Mir Qasim, Revenue Minister in charge of Agriculture, Government of Jammu & Kashmir, Srinagar/Jammu, Tawi.
17. Shri P. N. Thapar, I.C.S., Secretary to the Govt. of India, Ministry of Agriculture, New Delhi.
18. Shri A. D. Pandit, I.C.S., Chief Commissioner of Delhi, Delhi.
19. Shri Bajrang Bahadur Singh, Lt. Governor of Himachal Pradesh, Simla.

20. Shri P. C. Mathew, I.C.S., Chief Commissioner of Manipur, Imphal.
21. Shri T. G. N. Ayyar, I.C.S., Chief Commissioner of Andaman and Nicobar Islands, Port Blair.
22. Shri S. Moni, Administrator, Laccadive, Minicoy and Amindive Islands, Kozhikode.
23. Shri K. P. Bhargava, I.C.S., Chief Commissioner of Tripura, Agartala.
24. Shri K. Madhava Menon, Member, Rajya Sabha, "Padmalayam, Kozhikode, Malabar.
25. Shri Algu Rai Shastri, Member, Lok Sabha, Amila Town, District Azam Garh.
26. Shri K. G. Deshmukh, Member, Lok Sabha, Namuna Amravati, Bombay State.
27. Dr. H. K. Nandi, Director of Agriculture, West Bengal, Calcutta.
28. Dr. S. Dutta, Director of Animal Husbandry and Veterinary Services, West Bengal, Calcutta.
29. Shri M. P. Gandhi, C/o Gandhi and Co., Sir Pheroz Shah Mehta Road, Fort, Bombay.

APPENDIX VII

Standing Finance Committee

1. Shri P. N. Thapar, I.C.S., Secretary to the Government of India, Ministry of Agriculture, New Delhi.
2. Dr. M. S. Randhawa, I.C.S., Vice President, Indian Council of Agricultural Research, New Delhi.
3. Shri K. L. Ghei, Joint Secretary to the Government of India, Ministry of Finance, Food and Agriculture Division, New Delhi.
4. Shri P. Thimma Reddy, Minister for Agriculture, Government of Assam, Shillong.
5. Shri Gurbanta Singh, Minister for Agriculture, Government of Punjab, Chandigarh.
6. Shri Algurai Sashtri, Member, Lok Sabha, Amola Town, District Azamgarh, Uttar Pradesh.
7. Shri M. P. Gandhi of Gandhi & Co., Bombay.
8. Dr. R. Ahmed, Minister for Agriculture, Government of West Bengal, Calcutta.
9. Dr. S. Krishnamurthi, Professor of Agriculture, Annamalai University, Annamalainagar.
10. Shri B. R. Kapoor, Principal, Bihar Veterinary College, Patna.

APPENDIX VIII

Advisory Board

1. Dr. M. S. Randhawa, I.C.S., Vice-President, Indian Council of Agricultural Research, New Delhi.
2. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi.
3. The Animal Husbandry Commissioner with the Government of India, New Delhi.
4. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi.
5. Dr. M. B. Ghatge, Agricultural Marketing Adviser to the Government of India, New Delhi.
6. Dr. S. R. Sen, Economic and Statistical Adviser to the Government of India, Ministry of Agriculture, New Delhi.
7. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi.
8. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.
9. Shri Laxmi Sahai, Director, Indian Veterinary Research Institute, Izatnagar.
10. The Director, Indian Institute of Science, Bangalore.
11. Dr. K. C. Sen, Director, National Dairy Research Institute, Karnal.
12. Shri K. L. M. Ghose, Director, Central Rice Research Institute, Cuttack.
13. Dr. Pushkar Nath, Director, Central Potato Research Institute, Simla.
14. Shri I. J. Naidu, I.A.S., Director of Agriculture, Andhra Pradesh, Hyderabad—Deccan.
15. Shri L. K. Handique, Director of Agriculture, Assam, Shillong.
16. Shri B. P. Akhaury, Director of Agriculture, Bihar, Patna.
17. Dr. T. G. Shirname, Director of Agriculture, Bombay State, Poona.
18. Shri R. C. Murab, Director of Agriculture, Animal Husbandry and Veterinary Services, Madhya Pradesh, Bhopal.
19. Shri E. U. Damodaran, I.A.S., Director of Agriculture, Madras State, Madras.
20. Shri P. D. Nair, Director of Agriculture, Kerala State, Trivandrum.
21. Shri M. Mallaraj Urs, Director of Agriculture, Mysore State, Bangalore.
22. Shri G. C. Dash, Director of Agriculture and Food Production, Orissa, Cuttack.
23. Dr. Arjan Singh, Director of Agriculture, Punjab, Chandigarh.

24. Shri Samrath Raj, Director of Agriculture and Food Production, Rajasthan, Jaipur.
25. Shri Ram Surat Singh, Director of Agriculture, Uttar Pradesh, Lucknow.
26. Dr. H. K. Nandi, Director of Agriculture, West Bengal, Calcutta.
27. Shri G. M. Butt, Director of Agriculture, Jammu and Kashmir, Srinagar/Jammu Tawi.
28. Shri N. Bhagwandas, I.A S., Director of Animal Husbandry, Andhra Pradesh, Hyderabad-Deccan.
29. Shri S. M. L. Bhatnagar, I.A.S. Director of Veterinary Services and Animal Husbandry, Assam, Gauhati.
30. Shri S. K. Sen, Director of Animal Husbandry, Bihar, Patna.
31. Shri S. R. Chadha, Director of Veterinary Services, Bombay State, Poona.
32. Shri V. K. Madhava Menon, Director of Animal Husbandry, Kerala State, Trivandrum.
33. Shri D. Pattabhiraman, Director of Animal Husbandry, Madras State, Madras.
34. Director of Veterinary Services and Animal Husbandry, Orissa, Cuttack.
35. Shri K. S. Shetty, Director of Animal Husbandry and Veterinary Services, Mysore State, Bangalore.
36. Shri R. R. Gulati, Director of Veterinary Services and Chief Warden of Fisheries, Punjab, Simla.
37. Dr. P. G. Pande, Director of Animal Husbandry, Uttar Pradesh, Lucknow.
38. Dr. S. Dutta, Director of Veterinary Services and Animal Husbandry, West Bengal, Calcutta.
39. Shri V. L. Wazir, Director of Veterinary Services, Jammu and Kashmir, Srinagar/Jammu Tawi.
40. Shri K. L. Aggarwal, I.F.S., President, Forest Research Institute and College, P.O. New Forest, Dehra Dun.
41. Dr. C. G. Pandit, Director, Indian Council of Medical Research, New Delhi.
42. Dr. Radha Kamal Mukherjee, Vice Chancellor, Lucknow University, Lucknow.
43. Dr. V. S. Krishna, Vice Chancellor, Andhra University, Waltair.
44. Shri K. P. Bhatnagar, Vice Chancellor, Agra University, Agra.
45. Shri A. C. Joshi, Vice Chancellor, Punjab University, Chandigarh.
46. Shri H. Ferguson, Director, Scientific Department, Indian Tea Association, P.O. Cinnamara, Assam.
47. Shri B. L. Sethi, Secretary, Indian Central Cotton Committee, 14, Nicol Road, Ballard Estate, Bombay-1.
48. Shri B. K. Das, Member, Lok Sabha, P.O. Contai, District Midnapore, West Bengal.

49. Shri B. L. Singh, C/o M/s. Bhagirath Ram & Sons, 14, Bentinck Street, Calcutta.
50. Shri C. Bali Reddy, Secretary, Andhra Provincial Kisan Sammelan, Cumbum, District Kurnool.
51. Shri P. Balarama Kurup, Technochemical Industries, P.O. Box No. 74, Kozhikode, Malabar District.
52. Shri Mohanlal Ambalai Parikh, C/o Messrs Mohanlal Hargovindas, 51, Dadyseth Agiary Lane, Bombay-2.
53. Shri G. U. Rao, 54, Kondappa Chetty Street, G. T., Madras-1.
54. Shri C. T. Ithachin, B.Sc. Ag., Proprietor, Kotanad Estate, Kotanad South, Kerala State.
55. The Director of Remounts, Veterinary and Farms, Quarter-Master General's Branch, Army Headquarters, New Delhi.
56. Shri K. H. Srinivasan, 9, Crescent Road, High-Grounds, Bangalore-1.
57. Shri T. A. Jacob, Kaithyl House, Mangam, Kerala State.
58. Dr. D. Bhatia, Fisheries Development Adviser to the Government of India, New Delhi.
59. Dr. T. J. Mirchandani, Director, Soil Conservation Department, Damodar Valley Corporation, Hazari Bagh, Bihar.
60. Dr. E. S. Narayanan, Head of the Division of Entomology, Indian Agricultural Research Institute, New Delhi.
61. Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, New Delhi.
62. Dr. K. C. Naik, Headquarters Deputy Director of Agriculture, Madras State, Madras.
63. Col. R. N. Chopra, Director, Central Drug Research Laboratory, Srinagar/Jammu Tawi.
64. Dr. V. Subrahmanyan, Director, Central Food Technological Research Institute, Mysore.
65. Shri D. A. Gadkari, Joint Director of Agriculture (Engineering), Bombay State, Poona.
66. Dr. N. D. Kehar, Head of the Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar.
67. Shri Manilal B. Nanavati, President, Indian Society of Agricultural Economics, 46/48, Esplanade Mansion, Mahatma Gandhi Road, Fort, Bombay.
68. Shri S. S. Khot, Sheep and Wool Liaison Officer, Indian Council of Agricultural Research, New Delhi.
69. Shri S. G. Iyer, Head of the Division of Poultry, Indian Veterinary Research Institute, Izatnagar.
70. Dr. B. C. Kundu, Director, Jute Agricultural Research Institute, Barrackpore, Calcutta.
71. Shri Pritam Singh, Secretary, Indian Lac Cess Committee, Circular Road, Ranchi.
72. Shri P. P. Chandra, Secretary, Indian Central Sugarcane Committee, New Rohtak Road, New Delhi.
73. Dr. T. J. Gregory, Secretary, Indian Central Coconut Committee, Ernakulam.

74. Dr. M. S. Patel, Secretary, Indian Central Tobacco Committee, 38, Mount Road, Madras.
75. Dr. R. Sankaran, Secretary, Indian Central Oilseeds Committee, Gandhi Bhavan, Hyderabad-Deccan.
76. Shri K. Shamanna, Secretary, Indian Central Arecanut Committee, P. B. No. 28, Kozhikode-1, South India.
77. Dr. B. K. Mukherjee, Director, Indian Institute of Sugarcane Research Lucknow.
78. Dr. N. L. Dutt, Director, Sugarcane Breeding Institute, Coimbatore.
79. Dr. L. C. Sikka, Dairy Development Adviser to the Government of India, Ministry of Agriculture, New Delhi.
80. Sardar Lal Singh, Member, Lok Sabha, 70, North Avenue, New Delhi.
81. Dr. R. L. Kaura, Cattle Utilization Adviser to the Government of India, New Delhi.
82. Shri Bishan Mansingh, Chairman, U.P. Board of Agriculture, Fatehpur, Uttar Pradesh.

APPENDIX IX

Board of Research

1. Dr. M. S. Randhawa, I.C.S., Vice-President, Indian Council of Agricultural Research.
2. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India.
3. The Animal Husbandry Commissioner with the Government of India.
4. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India.
5. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research.
6. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.
7. Shri L. Sahai, Director, Indian Veterinary Research Institute, Izatnagar.
8. Dr. K. C. Sen, Director, Indian Dairy Research Institute, Bangalore.
9. Shri R. L. M. Ghose, Director, Central Rice Research Institute, Cuttack.
10. Dr. P. Pushkar Nath, Director, Central Potato Research Institute, Simla.
11. Dr. B. K. Mukherjee, Director, Indian Institute of Sugarcane Research, Lucknow.
12. Dr. N. L. Dutt, Director, Sugarcane Breeding Institute, Coimbatore.
13. Shri K. L. Aggarwal, I.F.S., President, Forest Research Institute, Dehra Dun.
14. Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, New Delhi.
15. Dr. E. S. Narayanan, Head of the Division of Entomology, Indian Agricultural Research Institute, New Delhi.
16. Dr. K. C. Naik, Principal Agricultural Institute and College, Coimbatore.
17. Col. R. N. Chopra, Director, Central Drug Research Laboratory, Srinagar, Jammu Tawi.
18. Shri D. A. Gadkari, Joint Director of Agriculture, (Engineering), Bombay State, Poona.
19. Dr. T. J. Mirchandani, Joint Director, Soil Conservation Department, Damodar Valley Corporation, Hazari Bagh, Bihar.

20. Dr. V. Subrahmanyan, Director, Central Food Technological Research Institute, Bangalore.

21. Dr. N. D. Kehar, Head of the Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar.

22. Shri S. S. Khot, Liaison Officer, Sheep and Wool, Indian Council of Agricultural Research.

23. Shri S. G. Iyer, Head of the Division of Poultry, Indian Veterinary Research Institute, Izatnagar.

24. Shri Manilal B. Nanavati, President, Indian Society of Agricultural Economics, Bombay.

25. The Dairy Development Adviser to the Government of India, Ministry of Agriculture, New Delhi.

APPENDIX X

Working Party on Agriculture of the Board of Research

1. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi.
2. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi.
3. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi.
4. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.
5. Shri R. L. M. Ghose, Director, Central Rice Research Institute, Cuttack.
6. Dr. Pushkar Nath, Director, Central Potato Research Institute, Patna.
7. Dr. B. K. Mukherjee, Director, Indian Institute of Sugarcane Research, Lucknow.
8. Dr. N. L. Dutt, Director, Sugarcane Breeding Institute, Coimbatore.
9. Shri K. L. Agarwal, President, Forest Research Institute, Dehra Dun.
10. Dr. T. J. Mirchandani, Joint Director, Soil Conservation Department, Damodar Valley Corporation, Hazari Bagh, Bihar.
11. Dr. E. S. Narayanan, Head of the Division of Entomology, Indian Agricultural Research Institute, New Delhi.
12. Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, New Delhi.
13. Dr. K. C. Naik, Principal, Agricultural Institute and College, Coimbatore.
14. Dr. V. Subrahmanyan, Director, Central Food Technological Research Institute, Mysore.
15. Col. R. N. Chopra, Director, Central Drug Research Laboratory, Srinagar/Jammu Tawi.
16. Shri D. A. Gadkari, Joint Director of Agriculture (Engineering), Bombay State, Poona.
17. Shri Manilal B. Nanavati, President, Indian Society of Agricultural Economics, 46-48 Esplanade Mansions, Mahatma Gandhi, Road, Fort, Bombay.

APPENDIX XI

Working Party on Animal Husbandry of the Board of Research

1. The Animal Husbandry Commissioner with the Government of India, New Delhi.
2. Shri S. C. Roy, Agricultural Extension Commissioner with the Government of India, New Delhi.
3. Dr. V. G. Panse, Statistical Adviser, Indian Council of Agricultural Research, New Delhi.
4. Shri L. Sahai, Director, Indian Veterinary Research Institute, Izatnagar.
5. Dr. K. C. Sen, Director, National Dairy Research Institute, Karnal.
6. Dr. N. D. Kehar, Head of the Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar.
7. Shri S. G. Iyer, Head of the Division of Poultry, Indian Veterinary Research Institute, Izatnagar.
8. Dr. E. S. Narayanan, Head of the Division of Entomology, Indian Agricultural Research Institute, New Delhi.
9. Dr. L. C. Sikka, Dairy Development Adviser to the Government of India, Ministry of Agriculture, New Delhi.
10. Shri S. S. Khot, Sheep and Wool Liasion Officer, Indian Council of Agricultural Research, New Delhi.

APPENDIX XII

Scientific Committees

AGRONOMY COMMITTEE

1. Dr. R. K. Tandon, Director, Sugarcane Research, Shahjahanpur, U.P.
2. Dr. T. J. Mirchandani, Director, Soil Conservation Department, Damodar Valley Corporation, Hazaribagh, Bihar.
3. Shri K. L. Khanna, Director, Sugarcane Research, Pusa, Bihar.
4. Shri Kalidas Sawhney, Shanti Nivas, Lalaguda P.O., Secunderabad 17.
5. Dr. L. A. Ramdas, Head of the Division of Heat and Power, National Physical Laboratory, Hillside Road, New Delhi.
6. Dr. V. G. Vaidya, Officer on Special Duty, Office of the Director of Agriculture, Nagpur.
7. Shri H. R. Saini, House No. E. S. 55, Near Supdt. of Police Office, Civil Line, Jullundur City.
8. Dr. N. K. Anant Rao, Professor of Agronomy, Balwant Rajput College, Agra.
9. Shri P. A. Venketeswaran Iyar, Deputy Director of Agriculture, (Head Quarters) Office of the Director of Agriculture, Chepauk, Madras-5.
10. Dr. B. A. Chaugule, Professor of Agronomy, College of Agriculture, Poona.
11. Shri P. L. Patel, Head of the Agronomy and Plant Breeding Section, Institute of Agriculture, Anand.
12. Dr. L. C. Sikka, Dairy Development Adviser, Ministry of Agriculture, New Delhi.
13. Dr. Mukhtar Singh, Agronomist, Indian Agricultural Research Institute, New Delhi.
14. Shri A. T. Sanyal, Professor of Agronomy, Government Agricultural College, Rani Kutir, Tollygunje, Calcutta.

Ex-officio Members

1. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.
2. Dr. P. C. Raheja, Head of the Division of Agronomy, Indian Agricultural Research Institute, New Delhi.
3. Dr. R. D. Asana, Plant Physiologist, Division of Botany, Indian Agricultural Research Institute, New Delhi.

Botany Committee

1. Shri Boshi Sen, Director, Vivekananda Laboratory, Almora, Uttar Pradesh.
2. Dr. T. R. Mehta, Principal, Agricultural College, and Joint Director of Agriculture, Gwalior, (M. P.)
3. Dr. Laxmi Singh Negi, Director of Agriculture, Himachal Pradesh, Simla.
4. Shri V. M. Chavan, 898, Radha Niwas, Poona-4.
5. Shri R. B. Ekbote, Wheat Specialist to the Government of Madhya Pradesh, Hoshangabad (Powerkheda).
6. Shri P. D. Gadkari, Economic Botanist, Institute of Plant Industry, Indore.
7. Dr. A. C. Joshi, Director of Education, Punjab Education Department, Chandigarh.
8. Dr. R. H. Richaria, Principal, Bihar Agricultural College, Sabour.
9. Shri M. B. V. Narasingarao, 5/191, Daba Gardens, Waltair, R. S. and P. O.
10. Shri A. K. Paul, Economic Botanist to the Government of West Bengal, 1, Rani Kutir, Tollygunge, Calcutta-33.
11. Dr. A. Abraham, Professor of Botany, University of Travancore, Trivandrum.
12. Professor R. H. Dastur, 51, The Mal, Mhow, (Indore), Madhya Pradesh.
13. Shri B. N. Duara, Economic Botanist to the Government of Assam, Shillong.
14. Dr. A. K. Mitra, Economic Botanist to the Government of Uttar Pradesh, Kanpur.
15. Dr. P. C. Maheshwari, Dean of the Faculty of Science, and Head of the Department of Botany, University of Delhi, Delhi.
16. Dr. S. S. Solomon, Deputy Director of Agriculture, (Crop Research), Poona-5.
17. Shri P. W. X. Ponniah, Millet Specialist to the Government of Madras, Lawley Road Post, Coimbatore.

Ex-officio Members

1. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.
2. Dr. S. M. Sikka, Head of the Division of Botany, Indian Agricultural Research Institute, New Delhi.
3. Shri R. L. M. Ghosh, Director, Central Rice Research Institute, Cuttack.

Soil Science Committee

1. Dr. P. K. Dey, Principal and Professor of Chemistry, College of Agriculture, Rani Kutir, Calcutta-40.
2. Dr. H. N. Mukherjee, Principal, Agricultural College, Government of Bihar, Ranchi.
3. Dr. V. Subrahmanyan, Director, Central Food Technological Research Institute, P.O. V.V. Mohalla, Mysore.
4. Dr. H. L. Uppal, Director, Irrigation and Power Research Station, Punjab, Amritsar.
5. Dr. J. V. Bhat, Asstt. Professor of Fermentation, Technology Laboratory, Indian Institute of Science, Bangalore-3.
6. Dr. A. D. Desai, Deputy Director of Agriculture, Government of Mysore, Bangalore.
7. Dr. R. R. Agarwal, Agricultural Chemist to the Government of Uttar Pradesh, Kanpur.
8. Dr. N. Narayan, Agricultural Chemist, Government of Bombay State, Poona.
9. Shri S. S. Sirur, Agricultural Chemist, Government of Mysore, Bangalore.
10. Dr. R. H. Joshi, Agricultural Chemist, Agricultural Research Institute, Nagpur.
11. Dr. A. N. Puri, Director, Field Research Station, 10, Sussex Road, Bombay-27.
12. Dr. C. C. Shah, 15, Queens Garden, Poona-1.
13. Dr. S. K. Bhattacharya, Professor of Chemistry, Indian Institute of Technology, Kharagpur, (West Bengal).
14. Dr. S. D. Nijhawan, 338, Model Town, Ludhiana.
15. Dr. A. Mariakulandai, Government Agricultural Chemist, Agricultural College and Research Institute, Lawley Road P.O., Coimbatore.
16. Dr. S. V. Govindarajan, Soil Correlator, All-India Soil Survey Scheme, V Block, Kumara Park West Extension, Bangalore-3.
17. Shri D. V. Krishna Rao, Agricultural Chemist, Agricultural College, Bapatla, Andhra.

Ex-officio Members

1. Dr. S. P. Raychaudhuri, Head of the Division of Soil Science and Agricultural Chemistry, I.A.R.I., New Delhi.
2. Dr. J. K. Basu, Director of Soil Conservation, Central Soil Conservation Board, Ministry of Agriculture, New Delhi.
3. Dr. R. S. Gupta, Soil Conservation Officer, Soil Conservation Centre, Dehra Dun.

4. Dr. R. C. Hoon, Director, Central Water and Power Commission, Bikaner House, New Delhi.

5. Shri R. P. Talati, Compost and Sewage Devt. Officer, Ministry of Agriculture, New Delhi.

6. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.

Agricultural Economics Committee

1. Shri Manilal B. Nanavati, President, Indian Society of Agricultural Economics, 46-48, Esplanade Mansion, Mahatma Gandhi Road, Bombay-1.

2. Dr. G. D. Aggarwal, Agricultural Economist to the Government of U.P. and Professor, Agricultural College, Kanpur.

3. Prof. J. J. Anjaria, Economic Adviser, Department of Economic Affairs, Ministry of Finance, Government of India, New Delhi.

4. Prof. C. N. Vakil, Director, UNESCO Research Centre, P. O. Box No. 242, Calcutta.

5. Prof. D. G. Karve, Summer Queen, Arthur Bunder Road, Colaba, Bombay-6.

6. Dr. D. R. Gadgil, Gokhale Institute of Politics and Economics, Poona.

7. Dr. J. P. Niyogi, University Prof. of Economics and Head of the Department of Economics, University College of Arts and Commerce, Ashutosh Building, Calcutta.

8. Dr. V. K. R. V. Rao, Director, Delhi School of Economics, University of Delhi, Delhi-8.

9. The Secretary, Research Programme Committee, Planning Commission, Government of India, New Delhi.

10. Prof. M. L. Dantwala, Prof. of Agricultural Economics, University of Bombay, Bombay.

11. Dr. Jaswant Singh, Principal and Irwin Professor of Agriculture, College of Agriculture, Banaras Hindu University, Banaras U.P.

12. Shri S. K. Bedkar, Deputy Director of Agriculture, (Headquarters) Bombay State, Poona.

13. Dr. Arjan Singh, Director of Agriculture, Punjab, Ludhiana.

14. Shri Sachin Chaudhuri, Editor, Economic Weekly, 15, Tamarind Lane, Bombay-1.

15. Dr. S. R. Chadha, Director of Veterinary Services, Bombay State, Poona.

16. Dr. P. S. Lokanathan, Director-General, National Council of Applied Economic Research, 48/48, Chanakya Puri, New Delhi.

Ex-officio Members

1. The Economics and Statistical Adviser, Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi.
2. The Agricultural Marketing Adviser to the Government of India, Directorate of Marketing and Inspection, Ministry of Agriculture, New Delhi.
3. The Agricultural Commissioner with the Government of India, I.C.A.R., New Delhi.
4. The Statistical Adviser, I.C.A.R., New Delhi.
5. Dr. B. P. Pal, Director, I.A.R.I., New Delhi.

MEDICINAL PLANTS COMMITTEE

1. Dr. G. K. Karnadikar, Professor of Pharmacology, Medical College, Baroda.
2. Shri K. N. Kaul, Director, National Botanical Gardens, Lucknow.
3. Dr. D. P. Biswas, Director in charge, Medicinal Plants Scheme, Government of West Bengal, Old Hindustan Building, Calcutta-13.
4. Shri S. P. Sen, Bengal Chemical and Pharmaceutical Works, Limited, 94, Chitranjan Avenue, Calcutta.
5. Dr. B. Mukherjee, Director, Drug Research Institute, Lucknow.
6. Dr. N. K. Dutta, Assistant Director in charge, Department of Pharmacology, Haffkine Institute, Parel, Bombay-12.
7. Dr. M. S. Verma, Principal, Ayurvedic College, Banaras Hindu University, Banaras.
8. Dr. S. Dutta, Director of Veterinary Services and Animal Husbandry, West Bengal, Calcutta.
9. Col. R. N. Chopra, Director, Drug Research Laboratory, Jammu Tawi.

Ex-officio Members

1. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.
2. Shri P. M. Nabar, Drugs Controller, Ministry of Health, Government of India, New Delhi.
3. Dr. R. L. Bhadwar, Forest Research Institute, P. O. New Forest, Dehra Dun.
4. The Director, Indian Veterinary Research Institute, Izatnagar.
5. Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, New Delhi.

FRUIT AND VEGETABLE DEVELOPMENT COMMITTEE

1. Dr. M. S. Randhawa, I.C.S., Vice-President, I.C.A.R, New Delhi.
2. Shri K. L. Ghei, Financial Adviser, Ministry of Food and Agriculture, New Delhi.
3. Dr. M. B. Ghatge, Agricultural Marketing Adviser, Government of India, Directorate of Marketing and Inspection, P-Block, Raisina Road, New Delhi.
4. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.
5. Co-operation Adviser, Ministry of Agriculture, New Delhi.
6. Dr. M. K. Rau, Regional Botanist, Northern Circle, Botanical Survey of India, 63, Rajpur Road, Dehra Dun.
7. Shri P. L. Sahgal, Director, Small Industries Service Institute, 56, Sunder Nagar, New Delhi.
8. Shri D. C. Desikachari, Chief Director of Movement, Ministry of Food, New Delhi.
9. Dr. T. S. Gill, Assistant Chief, Agriculture Division, Planning Commission, New Delhi.
10. Dr. V. Subrahmanyan, Director, Central Food Technological Research Institute, Cheluvamba Mansion, Mysore.
11. Shri Syed Hassan, Advocate and President, Bihar Horticultural Society, Kadamkuan, Patna-3.
12. Shri Manakchand Kishandas, Horticulturist, Utram via Jalgaon, East Khandesh.
13. Shri D. Raghav Reddy, Penagaluru, Cuddapah Distt., South India.
14. Shri M. L. Garg, C/o. M/s. L. R. Brothers, Seedsmen and Nurserymen, Saharanpur (U.P.)
15. Shri K. U. Patel, C/o. M/s. Tins Products, Ltd., India Exchange Building, Calcutta-7.
16. Shri Jagdish Chatterji, 4-Ballardas Street, Calcutta-7.
17. Shri R. V. Kalikar, President, Vidarbha Co-operative Bank and President, Orange Growers' Association, Nagpur (Bombay State).
18. Shri S. K. Mirchandani, Additional Secretary, I.C.A.R. (Secretary).

CENTRAL SPICES AND CASHEWNUT COMMITTEE

1. Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, I.C.A.R., New Delhi.
2. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.
3. Dr. K. C. Naik, Principal, Agricultural College and Research Institute, Coimbatore, Madras State.
4. Dr. M. B. Ghate, Agricultural Marketing Adviser to the Government of India, P-Block, New Delhi.
5. Shri V. M. Srikumaran Nayar, Deputy Chief Controller of Imports and Exports, Ministry of Commerce and Industry, Government of India, New Delhi.

6. Director of Agriculture, Government of Kerala, Trivandrum.
7. Director of Agriculture, Government of Mysore, Bangalore.
8. Director of Agriculture, Government of Madras, Chepauk, Madras.
9. Director of Agriculture, Government of Madhya Pradesh, Bhopal.
10. Director of Agriculture, Andhra Pradesh, Guntur.
11. Director of Agriculture, Assam, Shillong.
12. Director of Agriculture, Orissa, Cuttack.
13. Director of Agriculture, Government of Bombay, Bombay.
14. Director of Agriculture, Government of West Bengal, Calcutta.
15. Additional Development Commissioner, Government of Kerala, Trivandrum.
16. Development Commissioner, Government of Mysore, Bangalore.
17. Development Commissioner, Government of Andhra Pradesh, Hyderabad.
18. Development Commissioner, Government of Madhya Pradesh, Bhopal.
19. Development Commissioner, Government of Assam, Shillong.
20. Shri K. V. Thomas, Sea View Estate, Mandakayam, Kerala.
21. Shri M. Hameed, C/o. M/s. Makkar Pillai & Sons, Alwaye, Kerala.
22. Shri K. N. P. Zantye, Malvan District, Ratnagiri, Bombay State.
23. Shri T. A. Bell, The Cashew and Pepper Export Promotion Council, Millington Island, Cochin.
24. Shri T. D. Venkataraman, The Cashew and Pepper Export Promotion Council, Willingdon Island, Cochin.
25. Shri S. Naraspaya, Member, Legislative Council, Mysore, Mangalore-3.

ENTOMOLOGY AND ANIMAL PESTS OF CROPS COMMITTEE

Members by Name

1. Dr. P. J. Dooras, Assistant Director in charge, Department of Entomology, Haffkin Institute, Bombay-12.
2. Dr. H. S. Pruthi, Punjab University College, Hoshiarpur.
3. Shri V. Thirmal Rao, Pathologist to Government of Andhra, Bapatla.
4. Dr. G. A. Patel, Entomologist to Government of Bombay, Agriculture College, Poona-5.
5. Dr. R. L. Gupta, Entomologist to Government of Madhya Pradesh, Rewa.
6. Dr. Mohammad Qadiruddin Khan, Entomologist to Government of Andhra Pradesh, Himayatsagar, Hyderabad-Deccan.
7. Dr. A. C. Sen, Entomologist to Government of Bihar, P. O. Sabour, Distt. Bhagalpur.

8. Dr. S. N. Banerjee, Entomologist to Government of West Bengal, Calcutta.
9. Dr. Sardar Singh, Entomologist to Government of Punjab, Ludhiana.
10. Dr. A. S. Srivastava, Entomologist to Government of Uttar Pradesh, Kanpur.
11. Shri K. P. Anantanarayanan, 37-A, Bashyakarllu Naidu Road, R. S. Puram P.O., Coimbatore.
12. Dr. M. Puttaradiah, Entomologist to Government of Mysore.
13. Dr. R. L. Mathur, F. R. I., Dehra Dun.

Ex-officio Members

1. Dr. K. B. Lal, Plant Protection Adviser to the Government of India, Directorate of Plant Protection, Quarantine and Storage, Ministry of Food and Agriculture, Government of India, New Delhi.
2. The Director of Storage, Storage Directorate, Directorate-General of Food, Ministry of Food and Agriculture, Government of India, New Delhi.
3. Dr. E. S. Narayanan, Head of the Division of Entomology, I.A.R.I., New Delhi.
4. Dr. M. L. Roonwal, Director, Zoological survey of India, Calcutta.
5. Dr. B. P. Pal, Director, I.A.R.I., New Delhi.

Floriculture Committee

Ex-officio Members

1. Dr. M. S. Randhawa, Vice-President, I.C.A.R.
2. Dr. B. N. Uppal, Agricultural Commissioner, I.C.A.R.
3. Dr. R. J. Kalamkar, Additional Agricultural Commissioner, I.C.A.R.
4. Shri S. K. Mirchandani, Addl. Secretary, I.C.A.R.
5. Dr. Sham Singh, Dy. Agricultural Commissioner (FD), I.C.A.R.
6. Dr. S. M. Sikka, Head of the Division of Botany, I.A.R.I., New Delhi.
7. Dy. Financial Adviser, I.C.A.R. (Shri P. N. Suri).

Members by Name

1. Raja Bajrang Bahadur Singh, Lt.-Governor, Himachal Pradesh, Simla.
2. Shri C. D. Deshmukh, Chairman, University Grants Commission, Old Mill Road, New Delhi.
3. Dr. B. P. Pal, Director, I.A.R.I., New Delhi.
4. The Superintendent, Government Gardens, Ootacamund.
5. Shri M. B. Raizada, Forest Botanist, F.R.I., Dehra Dun.
6. Shri M. L. Garg, Proprietor, M/s. L. R. Brothers, Saharanpur.
7. Shri Bhanu L. Desai, Consultant Landscape Architect and Horticulturist, Dilkush, 3, Cross Road, Poona-1.
8. Shri D. S. Pradhan, Proprietor, Chandra Nursery, Rhenock, Sikkim State, (West Bengal) India.

9. Shri B. V. Bhagwat, Superintendent, Empress Garden, Poona.
10. Shri P. N. Kohli, near Exhibitions Ground, Srinagar (Kashmir).
11. Shri S. Madhava Rao. Garden Supdt., Department of Archeology, Curzon Road Barracks, New Delhi.
12. Dr. J. S. Patel, Adviser. Agriculture, Ministry of Community Development, New Delhi.
13. Dr. M. H. Marigowda, Suptd., Government Botanic Gardens, Lal Bagh, Bangalore.
14. Dr. D. N. Srivastava, Dy. Director of Horticulture, U.P.
15. Shri L. K. Handique, Director of Agriculture, Assam, Shillong.
16. Shri L. Venkataratnam, Horticulturist, Andhra Pradesh, Hyderabad.
17. A representative of the Plant Protection Organization (Shri V. K. Subramanyan, Quarantine Entomologist).
18. Dr. L. B. Singh, Horticulturist, Saharanpur (U.P.).

Horticulture Committee

1. Sardar Bal Singh Bajwa, late Fruit Specialist to the Government of Punjab, Jullundur City.
2. Shri Pradymna Singh, Horticulturist to Government of Madhya Pradesh, V. T. I. Building, Maharaj Bagh, Nagpur.
3. Dr. K. C. Naik, Principal, Agricultural College and Research Institute, Lawley Road P.O., Coimbatore.
4. Shri N. Gopala Krishna, Horticulturist to Government of Bombay, Agricultural College, Poona-5.
5. Sardar Kirpal Singh, Fruit Specialist to Government of Punjab, Patiala.
6. Prof. W. B. Hayes, Head of the Department of Horticulture, Allahabad Agricultural Institute, Allahabad.
7. Shri P. C. Mallick, Horticulturist to the Government of Bihar, Agricultural College, P.O., Sabour, Distt. Bhagalpur (Bihar).
8. Shri S. C. Bhattacharya, Officer on Special Duty, (Agricultural Marketing) Office of the Director of Agriculture, Assam, Shillong.
9. Dr. Pushkar Nath, Director, Central Potato Research Institute, Simla.
10. Shri A. R. Thapar, Horticultural Officer, Himachal Pradesh, Simla.
11. Shri L. Venkatratnam, Horticulturist to the Government of Andhra, Hyderabad-Deccan.
12. Dr. S. K. Mukerji, Horticulturist to the Government of West Bengal, P. O. Krishnanagar, Distt. Nadia, West Bengal.
13. Dr. Girdhari Lal, Assistant Director (Fruit Technology), Central Food Technological Research Instt., Cheluvamla Mansion, V. V. Mohalla P. O., Mysore.

14. Dr. S. S. Purewal, Vegetable Botanist to Government of Punjab, Agricultural College, Ludhiana.
15. Dr. L. B. Singh, Horticulturist Fruit Research Station, Saharanpur (U.P.)

Ex-officio Members

1. Dr. P. K. Kymal, Technical Adviser, Ministry of Food, Government of India, New Delhi.
2. The Agricultural Marketing Adviser to the Government of India, Directorate of Marketing and Inspection, Ministry of Food and Agriculture, New Delhi.
3. Dr. B. P. Pal, Director, Indian Agril. Research Instt., New Delhi.
4. Dr. S. M. Sikka, Head of the Division of Botany, Indian Agricultural Research Institute, New Delhi.
5. Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, New Delhi.
6. Dr. R. L. Nagpal, Horticulturist-in-Charge, Micro-nutrient Scheme, Agricultural College, Poona.
7. Shri U. S. Kang, Vegetable Specialist, Jammu and Kashmir State, Srinagar.
8. A representative of the Community Project Administration, New Delhi.

Agricultural Engineering Committee

1. Shri D. A. Gadkari, Joint Director of Agriculture (Engineering), Bombay State, Poona-1.
2. Shri A. A. Menon, Agricultural Engineer to the Government of Bombay, Agricultural College, Poona-5.
3. Shri C. P. Raju, Headquarters Agricultural Engineer, Office of the Director of Agriculture and Fisheries, Andhra State, Madras.
4. Shri B. N. Bannerjee, Joint Director of Agricultural Engineering, West Bengal, Calcutta.
5. Shri S. K. Paul, Agricultural Engineer (Implements), (Punjab), Ludhiana.
6. Shri H. N. Bhattacharya, Agricultural Engineer, Assam, Gauhati.
7. Shri A. C. Pandya, Assistant Professor of Agricultural Engineering (Farm Power Machinery) Deptt. of Agricultural Engineering, Indian Institute of Technology, Kharagpur, S. E. Rly.
8. Shri P. L. Goel, Divisional Engineer (S), Central Tractor Organisation, New Pusa, New Delhi.
9. Shri B. S. Kumar, Agricultural Engineer (Boring), Agril. Department, Ludhiana.
10. Shri C. S. Iyer, Agricultural Engineer to Government, Madhya Pradesh, Rewa.
11. Shri H. V. Bhargav. Agricultural Engineer, C/o. Director of Agriculture, U.P., Lucknow.

12. Shri A. D. Chugani, Agricultural Engineer, Bihar, Patna.
13. Shri V. Subba Raju, Agricultural Engineer, Government of Hyderabad, Hyderabad Dn.

Ex-officio Members

1. Shri J. S. Manku, Officer-in-charge, Division of Agricultural Engineering, Indian Agricultural Research Institute, New Delhi.
2. Shri D. N. Khadekar, Agricultural Engineer, Directorate of Extension and Training, Ministry of Food and Agriculture, Government of India, New Delhi.
3. Shri Mahavir Prasad, Irrigation Adviser, Ministry of Food and Agriculture, (Department of Agriculture), Government of India, New Delhi.
4. Shri I. S. Ghulati, Deputy Development Officer, Office of the Development Commissioner, Small-scale Industries, 114, Sundarnagar, New Delhi.
5. Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.

PLANT DISEASES COMMITTEE

1. Dr. S. Chattopadhya, Plant Pathologist to the Government of West Bengal.
2. Dr. R. S. Mathur, Plant Pathologist to the Government of Uttar Pradesh, Agricultural College, Kanpur.
3. Dr. J. N. Mishra, Plant Pathologist to the Government of Bihar, P.O. Sabour, District Bhagalpur.
4. Dr. Kishan Singh Bedi, Plant Pathologist to the Government of Punjab, Agricultural College, Ludhiana.
5. Dr. M. K. Patel, 12, Poona-Bombay Road, Poona-3.
6. Dr. T. S. Ramakrishna, Rubber Pathologist, Indian Rubber Board, Kottayam, Travancore-Cochin.
7. Dr. N. Prasad, Professor of Bacteriology and Plant Pathology, Institute of Agriculture, Anand (Western Railway).
8. Dr. Raghunath Prasad Asthana, Principal, Agricultural College, Nagpur.
9. Syed Vaheedudden, Plant Pathologist to the Government of Hyderabad, Himayatsagar, Hyderabad-Deccan.
10. Dr. T. S. Sadasivan, Director, Botany Laboratory, University of Madras, Madras.
11. Shri S. Chowdhury, Mycologist to the Government of Assam, Jorhat.
12. Shri M. K. Desai, Plant Pathologist to the Government of Bombay State, Poona-5.
13. Shri M. Govinda Rao, Mycologist to the Government of Andhra Agricultural College, Bapatla (Andhra State).

Ex-officio Members

1. Dr. B. P. Pal, Director, I.A.R.I., New Delhi.
2. Dr. R. S. Vasudeva, Head of the Division of Mycology, I.A.R.I., New Delhi.
3. Dr. P. R. Mehta, Dy. Director (Plant Diseases), Directorate of Plant Protection, Quarantine and Storage, Ministry of Food and Agriculture, Government of India, New Delhi.

STATISTICAL COMMITTEE

Members by name

1. Dr. K. R. Nair, Statistician, Forest Research Institute and College, P.O. New Forest, Dehra Dun.
2. Dr. U. S. Nair, Prof. of Statistics, Statistical Laboratory, University of Travancore-Cochin, Trivandrum.
3. Shri A. A. Rau, State Statistician and Agricultural Meteorologist, Government of Mysore, Bangalore.
4. Dr. K. Kishen, Chief Statistician to the Government of U. P., Department of Agriculture, Chhote Chutter Manzil, Lucknow.
5. Dr. P. K. Bose, Head of the Department of Statistics, Calcutta University, Calcutta.
6. Dr. N. S. R. Sastry, Director of Statistics, Reserve Bank of India, Bombay.
7. Shri H. V. Divetia, Director of Statistics, Government of Hyderabad, Hyderabad-Dn.
8. Dr. C. R. Rao, Prof. and Head of the Division of Research and Training Indian Statistical Institute, 203, Barrackpore Trunk Road, Calcutta-35.
9. Shri Ranga Rao, Statistician, Department of Agriculture, Bombay State, Poona.

Ex-officio Members

1. Statistical Adviser, Indian Council of Agricultural Research, New Delhi.
2. Deputy Statistical Adviser, Indian Council of Agricultural Research, New Delhi.
3. The Economic and Statistical Adviser, Directorate of Economics and Statistics, Ministry of Food and Agriculture, New Delhi.
4. The Agricultural Marketing Adviser to the Government of India, New Delhi.
5. The Joint Director, Central Statistical Organisation, New Delhi.
6. Dr. P. C. Raheja, Head of the Division of Agronomy, Indian Agricultural Research Instt., New Delhi.

Animal Breeding Committee

Members by name

1. Shri K. J. Devadanam, Deputy Director (Animal Husbandry). Andhra Pradesh, Hyderabad-Deccan.
2. Shri S. K. Sen, Director of Animal Husbandry, Bihar, Patna.
3. Shri B. G. Oka, Livestock Expert to the Government of Bombay, Poona.
4. Shri M. Dharmarajan, Professor of Animal Genetics, Madras Veterinary College, Madras.
5. Shri G. B. Singh, Director of Animal Husbandry and Veterinary Services, Orissa, Cuttack.
6. Shri H. B. Shahi, Animal Husbandry Commissioner-*cum*-Additional Secretary to Government, Animal Husbandry Department, U.P., Lucknow.
7. Shri R. B. Singh, Geneticist, Livestock Research Station, Mathura.
8. Dr. R. L. Kaura, Livestock Development Adviser to the Government of India, Ministry of Food and Agriculture, New Delhi.
9. Dr. P. Bhattacharya, Head of the Division of Animal Genetics, Indian Veterinary Research Institute, Izatnagar.
10. Shri S. G. Iyer, Head of the Division of Poultry Research, Indian Veterinary Research Institute, Izatnagar.
11. Dr. M. D. Patel, Director, Institute of Agriculture, Anand.
12. Shri B. N. Handa, Director of Animal Husbandry and Veterinary, Rajasthan, Jaipur.
13. Shri Bishan Mansingh, Civil Lines, Fatehpur (U.P.).

Members by designation

14. The Director, Remounts, Veterinary and Farms (or his representative), Quarter Master General's Branch, Army Headquarters, New Delhi.
15. The Superintendent, Government Livestock Farm, Hissar.
16. The Superintendent (Farm), National Dairy Research Institute, Karnal.

Ex-officio Members

1. The Chairman, Poultry Committee.
2. The Chairman, Cross-Breeding Committee.
3. The Chairman, Wool Committee.
4. Officers of the Council.

Animal Nutrition Committee

Members by name

1. Dr. N. D. Kehar, Head of the Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar.
2. Dr. K. C. Sen, Director, National Diary Research Institute, Karnal.
3. Shri V. Mahadevan, Professor of Animal Nutrition, Madras Veterinary College, Madras-7.
4. Dr. Lal Chand Dharmani, Retired Agricultural Chemist, Anandpur Sahib, *Via* Sirhind, Rupar (N. Railway).
5. Dr. S. K. Talpatra, Professor of Animal Nutrition, U. P. College of Veterinary Science and Animal Husbandry, Mathura.
6. Shri P. M. Dabadgao, Assistant Agrostologist, Indian Agricultural Research Institute, New Delhi.
7. Shri H. R. Saini, Director of Agriculture, Punjab, Chandigarh.
8. Shri B. K. Das, Physiological Chemist, Assam, Gauhati.
9. Dr. R. L. Kaura, Cattle Utilisation Adviser to the Government of India, Ministry of Food and Agriculture, New Delhi.

Members by designation

10. Central Silviculturist, Forest Research Institute, Dehra Dun.
11. Dr. Balkrishna Mohanlal Patel, Officer-in-charge, Anand Regional Animal Nutrition Research Centre, Institute of Agriculture, Anand.
12. Dr. Radhavallav Chanda, Officer-in-charge, Eastern Regional Animal Nutrition Centre, Haringhata Farm, Calcutta.
13. Dr. M. L. Mathur, Officer-in-charge, Southern Regional Animal Nutrition Centre, National Dairy Research Institute, Bangalore.
14. The Animal Nutrition Officer, Animal Husbandry Department, Government of Orissa, Cuttack.
15. Dr. P. C. Raheja, Head of the Division of Agronomy, Indian Agricultural Research Institute, New Delhi.

Animals Diseases and Pests Committee.

Members by name

1. Shri V. R. Rajagopalan, Director of Livestock Research, Bihar, Patna.
2. Shri S. R. Chadha, Director of Veterinary Services, Bombay State, Poona.
3. Shri M. Y. Mangrulkar, Principal, Madhya Pradesh Veterinary College, Jabbulpore.

4. Shri G. S. Thapar, Mahatma Gandhi Marg, Lucknow.
5. Shri R. L. Kaushal, Principal, Madhya Bharat Veterinary College, Mhow.
6. Lt. Col. D. R. Sahni, Asstt. Director of Remounts, Veterinary and Farms, Q.M.G's Branch, Army Headquarters, New Delhi.
7. Dr. H. D. Srivastava, Research Officer (Helminthology) and Pathology, I.V.R.I., Izatnagar, U.P.
8. Shri M. R. Dhanda, Head of the Division of Bacteriology and Pathology, I.V.R.I., Mukteswar, U.P.
9. Shri K. S. Shetty, Director, Veterinary Science, Hyderabad State, Hyderabad Deccan.
10. Dr. H. N. Ray, Professor of Protozoology, School of Tropical Medicine, Chitranjan Avenue, Calcutta.-2.
11. Dr. C. Krishna Rao, Deputy Director of Animal Husbandry, Egmore, Madras-8.
12. Dr. S. Datta, Director of Veterinary Services and Animal Husbandry, West Bengal, Calcutta.
13. Shri B. N. Soni, Research Officer, Hides and Skins, I.V.R.I., Izatnagar.

Members by designation

14. Shri L. Sahai, Director, I.V.R.I., Izatnagar.
15. The Research Officer, (Entomology), I.V.R.I., Izatnagar, U.P.

Ex-officio Members

Animal Husbandry Commissioner, Assistant Animal Husbandry Commissioner, Secretary, I.C.A.R., and Statistician, (Animal Husbandry).

Central Rinderpest Control Committee

1. Vice-President, Indian Council of Agricultural Research, (Chairman).
2. Animal Husbandry Commissioner with the Government of India, Indian Council of Agricultural Research, New Delhi.
3. Director, Indian Veterinary Research Institute, Izatnagar, U.P.
4. Director of Animal Husbandry and Warden of Fisheries, Punjab, Simla.
5. The Director of Animal Husbandry and Fisheries, Andhra Pradesh, Hyderabad (Dn.).
6. Director of Animal Husbandry, Bihar State, Patna.
7. Director of Veterinary Services, Bombay State, Poona.
8. Animal Husbandry Officer, Himachal Pradesh, Simla.
9. Director of Animal Husbandry, U.P., Lucknow.

10. Director of Veterinary Services and Animal Husbandry, West Bengal, New Secretariat Buildings, No. 1, Hastings Street, Calcutta.

11. Director of Animal Husbandry and Veterinary Services, Madhya Pradesh, Rewa.

12. Director of Animal Husbandry and Veterinary Services, Orissa State, Cuttack.

13. Director of Veterinary and Animal Husbandry, Rajasthan State, Jaipur.

14. Secretary, Central Rinderpest Control Committee, Indian Council of Agricultural Research, New Delhi.

15. Head of the Division of Pathology and Bacteriology, Indian Veterinary Research Institute, Mukteshwar-Kumaon (U.P.).

16. Head of the Division of Biological Products, Indian Veterinary Research Institute, Izatnagar, (U.P.).

17. Statistical Adviser, Indian Council of Agricultural Research, New Delhi.

18. Secretary, Indian Council of Agricultural Research, New Delhi.

19. Livestock Development Adviser to the Government of India, Ministry of Food and Agriculture, New Delhi.

20. Financial Adviser to the Ministry of Agriculture (Misc. F. Branch) Ministry of Finance, Government of India, New Delhi.

21. Director, Remount, Veterinary and Farms, Ministry of Defence, Government of India, New Delhi.

22. Deputy Secretary to the Government of India, Ministry of Food and Agriculture, (Agri.) (Visitor for such meetings as are held at Headquarters).

Dairy Science Committee

Members by name

1. Dr. Z. R. Kothavalla, No. 8, Ali Askar Road, Bangalore.

2. Shri G. S. Godbole, Dairy Development Officer, Bombay State, Poona.

3. Shri N. K. Bhargava, Dairy Development Officer, Co-operative Department, U.P., Lucknow.

4. Shri D. N. Khurody, Milk Commissioner, Wakefield House, Ballard Estate, Bombay.

5. Professor James N. Warner, Head of Dairy Department, Allahabad Agricultural Institute, P.O. Agricultural Institute, Distt. Allahabad.

6. Shri V. Kurein, Manager, Kaira District Co-operative Milk Producers' Union, Ltd., Anand.

7. Col. T. Murari, 1/2, Landan's Raod, Kilpauk, Madras.

8. Shri N. Srirama Reddy, President, Mysore Dairymen's Association, the Model Diary Farm, "Range Gowd" Buildings, Madhavnagar, High Grounds, Bangalore-1.

Members by designation

9. The Milk Commissioner, West Bengal, Writers' Buildings, Calcutta.

10. The Director of Remounts, Veterinary and Farms, Quarter Master General's Branch, Army Headquarters, New Delhi.

11. The Dairy Development Adviser to the Government of India, Ministry of Agriculture, New Delhi.

12. The Director, National Dairy Research Institute, Karnal.

13. The Dairy Husbandry Officer, National Dairy Research Institute, Bangalore.

14. The Dairy Chemist, National Dairy Research Institute, Bangalore.

15. The Dairy Bacteriologist, National Dairy Research Institute, Karnal.

16. The Dairy Technologist, National Dairy Research Institute, Karnal.

Ex-officio Members

Officers of the Council.

Goat, Sheep and Wool Committee

Members by name

1. Shri S. S. Khot, Liaison officer (Sheep and Wool), Indian Council of Agricultural Research, New Delhi.

2. Dr. C. Nanjundiah, Director, Technological Laboratory, Indian Central Cotton Committee, Matunga, Bombay-19.

3. Shri B. K. Vaidya, Assistant Director, Textile Research Institute ; Ahmedabad Textile Industry's Research Association Navrangpura, Ahmedabad.

4. A representative of the Wool Merchants' Association, Fazilka (Shri B. K. Sinha, 6A/58, Western Extension Area, Karol Bagh, New Delhi.)

5. Shri S. V. Sathe, Representative, Khadi and Village Industries Commission, Ministry Bhawan, Dinshaw Walcha Road, Bombay-1.

6.-7. Two representatives of the All India Wool Traders' Federation, Post Box No. 105, Bombay-1.

(New representatives are nominated by the Federation for each of the meetings of the Committee).

8. Shri N. L. Narayan, Deputy Director, Sheep and Wool, Government of Rajasthan, Bikaner.

9. Shri Manoobhai Doongursee, C/o. Doongursee and Sons, Maneckji Wadi Building, 107, Mahatma Gandhi Road, Fort, Bombay-1.

10. A representative of the Government of Uttar Pradesh (Shri H. K. Lall, Deputy Director of Animal Husbandry, Uttar Pradesh (Lucknow).

11. Sardar Gurbax Singh Mahal, Research Officer, Sheep Research Station, Government Livestock Farm, Hissar.

12. Shri E. B. Whitley, Director, International Wool Secretariat, Hamilton House, Block A, Post Box 451, Connaught Place New Delhi.

Members by designation

13. A representative of the Ministry of Commerce and Industry, Government of India, New Delhi. (Shri S. A. Teckchandani, Deputy Secretary to the Government of India, Ministry of Commerce and Industry, New Delhi).

14. The Agricultural Marketing Adviser to the Government of India, New Delhi (Shri H. S. Bawa, Senior Marketing Officer).

15. The Director, Indian Standards Institute, 19, University Road, Civil Lines, Delhi-8.

16. A representative of the Ministry of Community Development Government of India, New Delhi (Dr. P.M.N. Naidu, Adviser, Animal Husbandry).

Officers of the Council.

Poultry Committee

Members by name

1. Shri S. G. Iyer, Head of the Division, Poultry Research, Indian Veterinary Research Institute, Izatnagar (U.P.).

2. Shri R. M. Patil, Poultry Development Officer, Bombay, Poona.

3. Shri B. C. Joshi, District Livestock Officer, Madhya Pradesh, Rewa.

4. Shri P. C. Thomas, Poultry Development Officer, Government Poultry Farm, Manunuthi, Trichur, Kerala State.

5. Shri S. A. P. Prasad, President, Andhra Poultry Association, Kanchala, P.O. Pandyala, Distt. Krishna, Andhra Pradesh.

6. Major G. C. Juneja, Joint Director of Animal Husbandry (Head Quarters), U.P., Lucknow.

7. Shri B. M. Prasad, Deputy Director of Animal Husbandry, Chota Nagpur Range, Ranchi.

8. Principal, American Arcot Mission Agriculture Institute, Katpadi.

Members by designation

9. Representative of the Community Project Administration (Shri P. M. N. Naidu).

10. Poultry Development Officer, Madras.

11. Poultry Development Officer, Orissa, Cuttack.

Ex-officio Members

12. Dr. S. Bose, Research Officer, Poultry Division, Indian Veterinary Research Institute, Izatnagar (U.P.).

Officers of the Council.

Cross Breeding Committee

Members by designation

1. The Animal Husbandry Commissioner with the Government of India, New Delhi.

2. The Statistical Adviser, (in his absence the Statistician, Animal Husbandry), Indian Council of Agricultural Research, New Delhi.

3. The Director, Remounts, Veterinary and Farms, (or his representative), Quarter Master General's Branch, Army Headquarters, New Delhi.

4. The Head of the Division of Animal Genetics, Indian Veterinary Research Institute, Izatnagar.

5. The Deputy Livestock Adviser to the Government of India, Indian Council of Agricultural Research, New Delhi.

Members by name

6. Dr. L. C. Sikka, Dairy Development Adviser, Ministry of Food and Agriculture, New Delhi.
7. Lt. Col. T. Murari, No. 1/2, Landan's Road, Kilpauk, Madras-10.

Ad-hoc Wool Sampling Committee

1. Dr. V. G. Panse, Statistical Adviser, I.C.A.R.
2. Shri S. S. Khot, Liaison Officer, Wool Schemes, I.C.A.R.
3. Shri Gurbux Singh, Officer-in-charge, Sheep Breeding Scheme, Government Livestock Farm, Hissar.
4. Shri P. R. Yeri, Assistant Research Officer, Sheep Breeding Farm, Poona. (Co-opted member).

Ad-hoc Milk Costing Committee

1. The Animal Husbandry Commissioner with the Government of India, New Delhi.
2. The Statistical Adviser, Indian Council of Agricultural Research, New Delhi.
3. Dr. S. R. Sen, Economic and Statistical Adviser, Ministry of Food and Agriculture, New Delhi.
4. The Deputy Dairy Development Adviser, Ministry of Food and Agriculture, New Delhi.
5. Dr. K. C. Sen, Director of Dairy Research, Ministry of Food and Agriculture.
6. Prof. J. N. Warner, Head of the Department of Dairying, Allahabad Agricultural Institute, Allahabad.
7. Shri Y. V. Salpekar, Milk Costing Officer, Milk Commissioner's Office, Bombay.
8. Dr. Z. R. Kothavalla, 8, Ali Askar Road, Bangalore.

Ad-hoc Committee on Parasitology of Cattle

1. Dr. H. D. Srivastava, Head of the Division of Parasitology, Indian Veterinary Research Institute, Izatnagar.
2. Shri Anantaraman, Helminthiasis Research Officer, Madras Veterinary College, Madras.
3. Dr. N. S. Krishna Rao, Parasitologist, Mysore Serum Institute, Hebbal (Mysore).

4. Shri P. K. Sinha, Assistant Professor of Parasitology, West Bengal Veterinary College, Calcutta.

5. Dr. H. R. Mehra, Retired Professor of Zoology, University of Allahabad, 33, Chatham Lines, Allahabad.

6. Shri Karam Chand, Professor of Parasitology, Camp Veterinary College, Hissar (Punjab).

7. Dr. A. K. Verma, Research Officer, Livestock Research Section, Bihar P.O. Bihar Veterinary College, Patna.

8. Shri M. R. Mahajan, Secretary, Rinderpest Control Committee, I.C.A.R., New Delhi.

9. Dr. B. P. Pande, Professor of Parasitology, U.P. College of Veterinary Science, and Animal Husbandry, Mathura.

Ex-officio Members

Officers of the Council: Animal Husbandry Commissioner, Assistant Animal Husbandry Commissioner, Deputy Livestock Adviser, Secretary and Statistician.

Publications Committee

Dr. M. S. Randhawa, I.C.S., Vice-President, Indian Council of Agricultural Research, New Delhi.

Dr. B. N. Uppal, Agricultural Commissioner with the Government of India, New Delhi.

Shri L. Sahai, Animal Husbandry Commissioner with the Government of India, New Delhi.

Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi.

Shri N. D. Kehar, Director, Indian Veterinary Research Institute, Mukteswar.

Shri K. K. Iya, Director, National Dairy Research Institute, Karnal.

Dr. Ram Surat Singh, Director of Agriculture, Uttar Pradesh, Lucknow.

Dr. B. S. Kadam, Agricultural Extension Commissioner with the Government of India, New Delhi.

Shri J. S. Patel, Adviser, (Agriculture) Community Projects Administration, Planning Commission, New Delhi.

Dr. S. Dutta, Director of Veterinary Science and Animal Husbandry, West Bengal, Calcutta.

Shri D. Pattabhiraman, Director of Animal Husbandry, Madras.

Mr. M. J. E. Pritchard, Director of Publicity, Ministry of Food and Agriculture, New Delhi.

Dr. K. B. Lal, Plant Protection Adviser to the Government of India, New Delhi.

Shri A. C. Joshi, Vice-Chancellor, Punjab University, Chandigarh.

Dr. M. B. Ghatge, Agricultural Marketing Adviser to the Government of India, New Delhi.

Shri J. V. A. Nehemiah, Secretary, Indian Council of Agricultural Research, New Delhi.

Dr. U. N. Chatterjee, Editor, Indian Council of Agricultural Research, New Delhi.

APPENDIX XIII

Annual Accounts of Income and Expenditure of the Indian Council of Agricultural Research for the year 1955-56

RECEIPTS				PAYMENTS				
Head of the Account	Receipts during the year	Total Receipts	Original Grant	Net Grant	Head of the Account	Expenditure during the year	Excess(—) or savings (+) over net grant	Remarks
1	2	3	4	5	6	7	8	9
				PART I				
				A. Standing Charges				
OPENING BALANCE	Rs. a. p.	Rs. a. p.	Rs.	Rs.		Rs. a. p.	Rs. a. p.	
Cash Balance .	3,099 13 9		1,00,000	87,900	1. Accounts & Audit .	88,610 12 0	(—)710 12 0	(a) Inconsiderable
Bank Balance .	18,64,249 7 3							
Provident Fund .	86,402 3 9		9,000	2,600	2. Travelling allowance of non-official members of the Council.	3,428 1 0	(—)828 1 0	(a)
	19,53,751 8 9	19,53,751 8 9						
I. Receipts under the Agriculture Produce Cess Act.		49,12,413 10 0	25,000	16,800	3. Travelling allowance of members of the Committees, Advisory Board and other persons invited to attend the meetings.	16,642 9 0	(+)157 7 0	(a)

I. Contributions & grants:—												
(a) *From Constituent States :—*												
(i) Jammu & Kashmir.	5,000	0	0			2,000	500	4. T. A. of non-official members of the Board of Agriculture and Animal Husbandry in India.	457	3	0	(+)42 13 0 (a)
(ii) Hyderabad Deccan.	5,000	0	0									
(iii) Madras .	5,000	0	0									
(iv) Travancore-Cochin.	5,000	0	0									
(v) Coorg, Mercara.	15,000	0	0									
(vi) Saurashtra .	30,000	0	0									
	65,000	0	0	65,000	0	0	..	3,200	5. Miscellaneous .	3,523	2	9 (−)323 2 9 (a)
(b) *From Central Govt. and Ford Foundation for: :—*						65,200	70,000	6. Editorial staff for Indian Farming.	69,332	8	0	(+)667 8 0 (a)
(i) Research & Development of Pepper, Cashewnut etc.	24,860	0	0			..	12,900	7. Subsidies to various Journals.	12,829	0	0	(+)71 0 0 (a)
(ii) Improvement of Land Records and Agri. Statistics.	9,520	0	0			1,27,000	1,00,600	8. Integrated Statistical Scheme.	1,00,436	5	3	(+)163 10 9 (a)
(iii) Sample survey for the estimation of area and yield of pepper.	49,880	0	0			..	200	9. Publication of abstracts for Indian Journal of Veterinary Science.	191	8	0	(+)8 8 0 (a)

1	2	3	4	5	6	7	8	9
	Rs. a. p.	Rs. a. p.	Rs.	Rs.		Rs. a. p.	Rs. a. p.	
(iv) Improvement of Fisheries & Livestock Statistics.	53,000 0 0							
(v) Improvement of Land Records and Agri. Statistics.	8,120 0 0		..	92,800	10. Publicity Scheme .	92,483 13 3	(+)316 2 9	(a)
(vi) Study of milk yield, breeds and management practices of bovines in the Northern Region of India.	39,000 0 0		..	8,600	11. Publication of a Quarterly "Rice News Teller".	8,482 6 6	(+)117 9 6	(a)
			...	40,500	12. Publication of "Dharti-ke-lal".	39,952 6 6	(+)547 9 6	(a)
			..	5,000	13. Setting up of a Central Film library.	4,921 7 0	(+)78 9 0	(a)
			..	24,900	14. Press Section .	24,706 12 6	(+)193 3 6	(a)
			..	18,700	15. Printing of different series of publications issued by the Council.	18,595 13 6	(+)204 2 6	(a)
			..	41,400	16. Printing of handbook series of the Council.	40,934 10 0	(+)465 6 0	(a)

				..	34,500	17. Estt. of a Central Distribution Sec., for the Pub. of the Council.	34,304	7	9	(+)195	8	3	(a)
				..	14,900	18. Farm news and Press releases.	14,650	5	3	(+)249	10	9	(a)
				..	12,000	19. Abstraction of Horticultural literature.	11,893	6	6	(+)106	9	6	(a) Inconsiderable.
(vii) The publication of a Journal for village workers.	..	55,500	0 0										
(viii) Establishment of a Research Station for pepper.	..	50,000	0 0	..		B. RESEARCH—TRAINING AND PUBLICITY UNDER DIRECT CONTROL OF I.C.A.R.							
						(i) **Agriculture**							
(ix) Research and development of Pepper and Cashewnuts etc.	..	3,925	0 0	..									
(x) Crop-cutting Survey on Sugarcane.	..	37,900	0 0	..	400	20. Experiments on Katha phosphate and dicalcium phosphate.	314	10	0	(+)85	6	0	(a)
(xi) The development of pepper, Madras.	..	76,000	0 0	2,700	52,800	21. Co-ordinated pasture land, Grassland Survey Scheme.	54,205	10	0	(−)1,405	10	0	(a)

1	2	3	4	5	6	7	8	9
	Rs.	Rs. a. p.	Rs.	Rs.		Rs. a. p.	Rs. a. p.	
(xii) Composite Res. Station for black Pepper, Cashewnuts etc.	..	15,000 0 0	..	400	22. Supplement to Monograph on the Fungi of India.	352 12 3	(+)47 3 9	(a)
(xiii) Expts. on Indian Farm Youth Exchange.	..	2,311 0 0	..	8,100	23. Grape Show, Hyderabad.	8,079 2 0	(+)20 14 0	(a)
(xiv) International Farm Youth exchange programme.	..	3,800 0 0	19,300	17,500	24. Description of different varieties of fruit.	17,174 7 3	(+)325 8 9	(a)
(xv) Weed Control Scheme.	..	32,200 0 0	..	1,500	25. Grassland expert of the F.A.O.	1,436 3 0	(+)63 13 0	(a)
(xvi) Improvement of Fisheries and Livestock Statistics.	..	65,000 0 0	530	4,800	26. Co-ordinated wheat rust control scheme.	4,721 5 0	(+)78 11 0	(a)
(xvii) Organisation of Agri. Exhibition at Colombo.	..	2,23,500 0 0	..	100	27. Spices Enquiry Committee.	27 2 0	(+)72 14 0	(a)
(xviii) Manurial trials.	..	56,100 0 0	..	500	28. Monograph on mechanical cultivation in India.	500 0 0	(+)	
(xix) Publicity of Japanese Method of Paddy Cultivation.	..	45,000 0 0						

(xx) Establishment of Res. Station for Cardamom.	13,000	0	0				33,000	19,900	29. Co-ordination of Research.	19,467	0	9	(+)432	15	3	(a)
(xxi) Cattle Sterility.	1,23,500	0	0													
(xxii) Res. and development of Pepper and Cashewnuts, etc.	2,080	0	0				..	1,600	30. Commercial production of hybrid maize.	1,516	0	0	(+)84	0	6	(a)
							..	300	31. Award of a prize for soil moisture determiner.	294	0	0	(+)6	0	0	(a)
							..	3,000	32. Survey of indigenous agricultural implements.	3,139	11	0	(−)139	11	0	(a)
	9,89,199	0	0	9,89,199	0	0	..	21,300	33. Agronomic Experiments and Manurial Experiments.	21,152	6	0	(+)147	10	0	(a)
									(ii) **Animal Husbandry**							
							..	1,100	34. Monograph on "Chemotherapy of animal trypanosomiasis"	1,009	2	3	(+)90	13	9	(a)
(c) *From other sources*:—																
Indian Central Sugarcane Committee.	1,000	0	0	1,000	0	0	50,000	47,800	35. Cost of milk production.	47,476	14	9	(+) 323	1	3	(a)

1	2	3	4	5	6	7	8	9
	Rs. a. p.	Rs. a. p.	Rs.	Rs.		Rs. a. p.	Rs. a. p.	
III. Interest from Investments:—								
1) Interest on S.B. Account No. 48041.	664 0 0							
(2) Interest on 3½% National Plan loan, 1964.	645 10 0							
(3) 2½% loan, 1953.	39,827 8 0							
(i) 2¼% loan, 1962.	26,059 8 0							
(ii) 3% loan, 1963-65.	49,961 4 0		8,600	4,600	36. Cattle Sterility .	4,478 2 0	(+)121 14 0	(a)
(iii) 3% 2nd Victory loan, 1959-61.	14,962 8 0		3,000	35,100	37. Expansion of central herdbook section.	34,940 14 0	(+)159 2 0	(a)
(iv) 3% Victory loan, 1957.	55,540 12 0					..	..	
(v) 3% loan, 1973-75.	1,88,808 12 0					..	..	
(vi) 3½% Govt. National Plan Bonds, 1961.	35,310 8 0		..	300	38. Training centre for experimental designs in Agri. and Animal Husbandry	167 5 6	(+)132 10 6	(a)
(vii) Fixed Deposits etc.	4,880 13 0		...	800	39. Assignment of Sheep and Wool Export of the F.A.O.	776 13 6	(+)23 2 6	(a)
	4,16,067 3 0							

IV. Miscellaneous Receipts:—												
(i) Receipts realised from Schemes.	35,777 13 6			..	300	40. Printing of Handbook of Statistics for the use of Agri. Research workers.	238 1 6	(+)61 14 6	(a) Inconsiderable.			
(ii) Receipts on account of unspent balances of grants made by the Council.	16,763 2 0			81,300	36,600	41. National Index of Field Expts.	36,356 10 0	(−)243 5 6	(a)			
(iii Miscellaneous.	5,57,801 6 3			7,200	2,900	42. Award of fellowships to the diploma course students in Agri. Statistics.	2,821 0 0	(+)79 0 0	(a)			
Total Miscellaneous Receipts.	6,10,342 5 9	6,10,342 5 9		..	13,400	43. Potentialities of Indian village cattle for increased milk production through better feeding and management.	13,240 4 6	(+)159 11 6	(a)			
V. Debts & Remittances:—												
(i) *Loans and Advances*												
(1) Refund of Cycle Advance.	3,225 6 0			1,750	2,800	45. Award of fellowship in dairying, I.D.R.I.	2,800 0 0	..				
(2) Refund of Motor Cycle Advance.	354 5 0			4,140	8,200	46. Training course in livestock marketing.	8,110 0 0	(+)90 0 0				
(3) Refund of Motor car Advance.	678 0 0											
	4,257 11 0	4,257 11 0					..	..				

1	2	3	4	5	6	7	8	9
	Rs. a. p.	Rs. a. p.	Rs.	Rs.		Rs. a. p.	Rs. a. p.	
(ii) *Deposits and advances repayable*								
(a) Subscription	52,886 1 2		10,050	42,600	47. Camel Breeding, I.C.A.R.	42,577 1 6	(+)22 14 6	(a)
(b) Repayment of Advances from subscription.	2,454 0 0		24,430	34,200	48. Award of fellowship in A.H. subjects, I. C. A. R.	34,183 0 0	(+)17 0 0	(a)
					(iii) **Miscellaneous**			
(c) Interest on Advances.	155 13 0							
(d) Council's Contribution.	6,071 11 6		33,000	22,200	49. Library.	22,025 15 3	(+)174 0 9	(a)
(e) Lapse and forfeiture.						..	..	
(f) Interest from Investment etc.	645 10 0		1,91,770	4,06,900	50. Integrated publicity work.	1,06,781 12 0	(+)118 4 0	(a)
	62,213 3 8	62,213 3 8						
(g) Permanent advances.	400 0 0		1,610	900	51. Statistical analysis of data collected in breeding scheme at I.D.R.I.	897 12 0 ..	(+)2 4 0	(a)
(h) Suspense	493 0 0							
(i) Other deposits and advances repayable.	(—)27,584 14 0	(—)26,691 14 0						

(iii) *Recoveries from Research staff on account of income tax, provident fund etc.*												(a) Inconsiderable
(a) Income tax .	4,073	7	0			..	100	52. Compilation of "Agriculture and Animal Husbandry in India."	50	8	0	(+)49 8 0 (a)
(b) G. P. Fund .	6,386	13	0			..	1,11,000	53. Building of the I.C.A.R	1,10,773	4	3	(+)226 11 9 (a)
(c) Misc. Recoveries.	5,119	7	0			40,000	29,900	54. Indian Council of Agricultural and Veterinary Education.	29,823	6	0	(+)76 10 0 (a)
(d) Contributory Provident Fund.	6,781	0	0			..	1,000	55. Appointment of Shri J. Malcolm Orchard under Point Four programmes.	897	11	0	(+)102 5 0 (a)
	22,360	11	0	22,360	11	0						
Total Receipts and opening balance.				90,09,913	7	2	..	56. International farm youth exchange.	6,873	15	0	(+)26 1 0 (a)
Investment and Reinvestment.				22,97,100	0	0	..	57. Silver Jubilee celebrations of the Council.	8,901	4	9	(+)98 11 3 (a)
				1,13,07,013	7	2						
							..	58. Crop cutting experiments on jute.	1,266	5	0	(+)33 11 0 (a)
							..	59. Duplicating Section.	4,141	15	6	(+)58 0 6 (a)
							..	60. Village projects, Delhi.	2,874	0	0	(+)26 0 0 (a)

1	2	3	4	5	6	7			8			9
		Rs.	Rs.	Rs.		Rs.	a.	p.	Rs.	a.	p.	
			..	11,100	61. Printing of an Album of Indian Agriculture and Animal Husbandry.	10,993	7	3	(+)106	8	9	(a)
			..	9,100	62. Japanese method of paddy cultivation.	9,045	3	0	(+)54	13	0	(a)
			..	25,400	63. Livestock and fishery statistics.	25,291	3	0	(+)108	13	0	(a)
			..	1,19,600	64. Ceylon and Amritsar exhibitions.	1,16,494	6	0	(+)3,105	10	0	(a)
			..	3,07,500	65. Delhi Milk Supply.	3,07,490	0	6	(+)9	15	6	(a)
			1,00,000	10,000	66. Publication of "Dharti ke-lal" in regional languages.	1,000	0	0	..			
			..	3,200	67. Publication of Extension Newsletter for extension workers.	3,119	3	0	(+)80	13	0	(a)
			..	2,93,700	68. Building of the I.C.A.R. (Statistical Wing).	2,93,808	8	3	(—)108	8	3	(a)
			..	88,400	69. Setting up of a Farmers' Forum in the country.	88,311	5	0	(+)88	11	0	(a)

..	21,800	70. Preparation of reviews on research work done in India in the field of agriculture and animal husbandry.	21,631	14	3	(+)168	1	9	(a)		
..	2,400	71. PEPSU Exhibition	2,347	12	9	(+)52	3	3	(a)		
..	2,100	72. Fellowship-Res.Agri. & A.H.	2,012	6	0	(+)871	0	0	(a)		
..	400	73. Artificial Insemination Scheme.	41	9	0	(+)358	7	0	(a)		
..	5,400	74. Conference of Workers on Millets, Kolhapur.	5,232	3	6	(+)167	12	6	(a)		
..	1,900	75. Research Fellowship in Agri. & A.H. Services.	1,794	0	0	(+)106	0	0	(a)		
..	..	76. Preparation of monographs on Poisonous Plants of India.	200	0	0	(—)200	0	0	(a)		
		PART II—NEW SCHEMES									
		A. RESEARCH UNDER DIRECT CONTROL OF THE I.C.A.R.									
..	3,800	77. Appointment of Liaison Officer for Sheep & Wool Schemes.	3,707	1	0	(+)92	15	0	(a)	A.H. Head Quarter.	
..	17,200	78. All India Mango Shows.	17,093	7	0	(+)106	9	0	(a)	Agri. Head Quarter.	
..	17,900	79. Sugarcane Production.	17,693	15	0	(+)206	1	0	(a)	Misc. Head Quarter.	

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.	Rs. a. p.	
			..	10,200	80. Study of milk-yield breeds and management practices of bovines.	9,929 1 0	(+)270 15 0	(a)
			..	19,400	81. Training centre of land records.	19,299 1 6	(+)100 14 6	(a)
			..	24,300	82. Industrial Exhibition, Madras.	24,182 7 3	(+)117 8 9	(a)
			..	4,400	83. Pilot Sample Survey, Pepper.	4,981 9 0	(—)581 9 0	(a)
			..	6,900	84. Publication of Agricultural Information Newsteller.	6,818 0 0	(+)82 0 0	(a)
			..	12,700	85. Printing of Khoti .	12,638 4 9	(+)61 11 3	(a)
			..	28,700	86. Printing of Extension Guides.	28,685 14 9	(+)14 1 3	(a)
			..	15,400	87. Printing of Extension books for village workers.	15,263 4 6	(+)136 11 6	(a)
					B. GRANT-IN-AID			
					(i) Agriculture			
					(a) *Rice*			
			5,100	900	88. Improvement of paddy, M.B.	830 0 0	(+)70 0 0	(a) Inconsiderable
			4,000	13,400	89. Rice breeding, Punjab.	13,320 9 0	(+)79 7 0	(a)

8,400	4,800	90.	Do. Coorg	4,800	0	0	..				
3,100	27,900	91.	Usar land paddy, U.P. Survey & Collection of paddy, C.R.R.I.	27,806	0	0	(+)94	0	0	(a)
5,400	65,000	92.	Blast & foot rot diseases of rice & wheat, Bombay.	6,466	0	0	(+)34	0	0	(a)
4,420	9,300	93.	Boro Paddy, W. Bengal.	9,240	0	0	(+)60	0	0	(a)
5,600	5,000	94.	Breeding salt & flood resistant varieties, Assam.	5,000	0	0	..			
8,400	7,900	95.	Do. Travancore-Cochin	7,895	13	0	(+)4	3	0	(a)
17,900	10,300	96.	Do. W. Bengal.	11,068	12	0	(—)768	12	0	(x)
7,600	7,600	97.	Scheme for work on rice in saline areas, Andhra.	7,581	12	0	(+)18	4	0	(a)
..	1,000	98.	Japanese method of rice cultivation, Coorg.	1,000	0	0	..			
..	1,100	99.	Do. Mysore .	1,027	0	0	(+)73	0	0	(a)
..	1,800	100.	Do. Orissa .	1,780	0	0	(+)20	0	0	(a)
..	1,200	101.	Do. W.Bengal	1,180	0	0	(+)20	0	0	(a)
..	2,600	102.	Do. Bihar .	2,600	0	0	..			(+)
..	1,900	103.	Do. Andhra .	1,810	0	0	(+)90	0	0	(a)

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.	Rs. a. p.	
			..	1,200	104. Japanese method of rice cultivation, M.P.	1,150 0 0	(+)50 0 0	(a)
			..	320	105. Do. Uttar Pradesh.	3,820 0 0	(−)3,500 0 0	(x) x Demand for funds received very late during the year.
			..	2,900	106. Do. Bombay .	6,416 0 0	(−)3,516 0 0	(x)
			..	1,600	107. Do. Madras .	1,510 0 0	(+)90 0 0	(a)
			5,100	3,900	108. Physiology of Rice Flowering, West Bengal.	3,820 0 0	(+)80 0 0	(a)
			6,500	4,300	109. Breeding varieties resistant to piricularia, Madras.	4,285 0 0	(+)15 0 0	(a)
			..	..	110. Do. Andhra .	1,800 0 0	(−)1,800 0 0	(x)
			..	..	111. Study on Paddy Agromyzon, Hyderabad.	1,460 0 0	(−)1,460 0 0	(x)
			5,000	4,700	112. Rai diseases of paddy, —Kashmir.	4,700 0 0	..	
			4,700	10,800	113. Manurial experiments on paddy lands, W, Bengal,	10,772 3 6	(+)27 12 6	(x) (a)

3,900	5,200	114.	Improvement of Hill Paddy, Assam.	5,200	0	0	..				
28,600	22,400	115.	Increasing rice yield, C.R.R.I.	22,348	0	0	(+)52	0	0	(a)
..	20	116.	Rice Breeding Schemes, Bulsar.	16	0	0	(+)4	0	0	(a)
			(b) *Wheat and other Cereals*								
5,290	12,000	117.	Maize Breeding, Punjab.	11,901	8	6	(+)98	7	6	(a)
9,200	7,000	118.	Do. U.P. .	6,977	0	0	(+)23	0	0	(a)
8,300	6,800	119.	Do. Bihar .	6,780	0	0	(+)20	0	0	(a)
14,000	11,600	120.	Do. W. Bengal	11,539	7	0	(+)60	9	0	(a)
..	..	121.	Do. Almora .	1,302	4	0	(−)1,302	4	0	(x)
4,200	2,300	122.	Hybrid Corn Seed—Almora.	2,217	9	3	(+)82	6	9	(a)
32,000	43,000	123.	Improvement of pastures and legumes, Madhya Pradesh.	4,220	0	0	(+)80	0	0	(a)
5,400	6,200	124.	Do. I.A.R.I.	6,200	0	0	..			
12,500	12,100	125.	Do. Bombay .	12,003	6	0	(+)96	10	0	(a)
6,000	4,500	126.	Foot rot of wheat, M.P.	4,500	0	0	..			
8,700	8,700	127.	Studies on wheat, Bombay.	8,720	0	0	(+)80	0	0	(a)

1	2	3	4	5	6	7	8	9
			2,300	11,900 14,300	128. Wheat Breeding, Bombay	11,865 0 0 14,220 0 0	(+)35 0 0 80 0 0	(a)
			1,000	19,800	129. Do. M.P.	19,781 6 0	(+)18 10 0	(a)
			..	10,100	130. Do. Hyderabad	10,001 10 0	(+)98 6 0	(a)
			..	2,000	131. Do. U.P.	2,000 0 0	..	
			1,220	5,000	132. Do. Punjab	5,000 0 0	..	
			..	400	133. Coordinated wheat rust control scheme (Mycological), Simla Delhi Agra (Botany,) Delhi. Pusa Simla Indore (M.B.)	328 0 0	(+)72 0 0	(a)
			34,100	18,900	134. Maize Breeding, I.A. R.I.	18,870 0 0	(+)30 0 0	(a)
			14,400	13,100	135. Do. Hyderabad.	13,063 2 0	(+)36 14 0	(a)
			..	2,300	136. Do. Rajasthan	2,300 0 0	..	
			840	6,300	137. Do. Pepsu	6,280 0 0	(+)20 0 0	(a)
			6,000	5,000	138. Wheat Breeding Rajasthan.	5,000 0 0	...	

3,500	3,200	139.	Barley improvement, Rajasthan.	3,200	0	0	..			
7,200	3,000	140.	Research on fodder production, W. Bengal.	3,000	0	0	..			
6,000	5,000	141.	Do. Bihar .	5,000	0	0	..			
3,900	3,400	142.	Do. Coorg .	3,310	0	0	(+)90	0	0	(a)
5,700	5,500	143.	Do. Bhopal .	5,458	0	0	(+)42	0	0	(a)
			(c) *Millets & Pulses*							
4,000	1,400	144.	Pulse breeding, Madhya Bharat, Gwalior.	1,311	2	0	(+)88	14	0	(a)
5,000	2,000	145.	Hybrid Bajra, Bombay.	2,000	0	0	..			
7,300	6,700	146.	Striga attack on Sorghum, Andhra.	6,700	0	0	..			
13,500	10,300	147.	Hybrid combu, Madras.	10,268	13	6	(+)31	2	6	(a)
1,640	900	148.	Gram Pests, M.P.	830	0	0	(+)70	0	0	(a)
11,000	7,200	149.	Jowar & Bajra breeding, Saurashtra.	7,180	0	0	(+)20	0	0	(a)
5,700	5,100	150.	Pulse Breeding, W. Bengal.	5,030	4	3	(+)69	11	9	(a)
5,000	4,600	151.	Storage & Viability of Pollen grains, Delhi University.	4,532	0	0	(+)68	0	0	(a)

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.		
					(d) *Fruits*			
			..	100	152. Physiology of pulses, Presidency College, Calcutta.	70 12 0	(+)29 4 0	(a)
			18,000	1,600	153. Horticulture, M.P.	1,544 0 0	(+)56 0 0	(a)
			28,200	21,500	154. Do. Hyderabad	21,481 3 6	(+)18 12 6	(a)
			10,300	12,000	155. Orange cultivation, Coorg.	12,000 0 0	..	
			17,700	22,300	156. Banana research, Madras.	22,262 12 10	(+)37 3 2	(a)
			7,400	6,200	157. Do. Bombay .	6,189 0 0	(+)11 0 0	(a)
			15,700	13,000	158. Do. W. Bengal .	12,947 10 6	(+)52 5 6	(a)
			4,000	4,700	159. Citrus Manurial Trials, Punjab.	4,626 0 0	(+)74 0 0	(a)
			11,420	4,400	160. Remedial measures against San Jose scale, Kashmir.	4,309 13 0	(+)90 3 0	(a)
			8,500	5,800	161. Chemical Composition & Nutritive value of Fruits and Vegetables—Coonoor.	5,736 0 0	(+)64 0 0	(a)
			5,200	7,600	162. Citrus root-stock trials, Andhra.	7,511 0 0	(+)89 0 0	(a)

10,000	17,600	163.	Investigation of micro-nutrients, I.A.R.I.	17,530 0 0	(+)70 0 0	(a)
31,000	31,000	164.	Citrus die-back diseases, Coorg.	31,000 0 0	..	
22,600	60,000	165.	Date Palm, Punjab.	60,000 0 0	..	
4,400	13,900	166.	Fruit Research Stations, U.P.	13,975 0 0	(−)75 0 0	(a)
..	100	167.	Fruit Preservation, Assam.	27 14 0	(+)72 2 0	(a)
1,800	100	168.	Mycological & Entomological Investigations of fruits, U.P.	71 0 0	(+)29 0 0	(a)
..	6,700	169.	Coordinated scheme on the effect of chemicals on the storage of fruits & vegetables, C.F.T.R.I.	6,670 0 0	(+)30 0 0	(a)
..	2,700	170.	Do. C.P.R.I.	2,680 0 0	(+)20 0 0	(a)
..	2,000	171.	Do. M.P.	2,000 0 0	..	
..	4,400	172.	Do. U.P.	4,400 0 0	..	
..	5,000	173.	Do. Bombay	5,000 0 0	..	

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.	Rs. a. p.	
			..	3,000	174. Coordinated scheme on the effect of chemicals on the storage of fruits & vegetables, Punjab	3,000 0 0	..	
			3,000	1,900	175. Improvement of Ber fruit, V.P.	1,810 0 0	(+)90 0 0	(a)
			3,000	6,600	176. Do. Pepsu	2,800 0 0	(+)3,800 0 0	(a)
			2,600	2,000	177. Do. M.P.	1,960 0 0	(+)40 0 0	(a)
			..	7,400	178. Citrus Fruit Research, M.P.	7,380 0 0	(+)20 0 0	(a)
			..	23,000	179. Fruit Research H.P.	23,000 0 0	..	
			..	9,700	180. Do. Orissa	9,640 0 0	(+)60 0 0	(a)
			..	1,700	181. Manual on fruit Research., C.F.T.R.I.	1,690 15 0	(+)9 1 0	(a)
			8,700	7,800	182. Cashewnuts, Madras	7,725 10 6	(+)74 5 6	(a)
			5,600	1,600	183. Do. Travancore-Cochin.	1,550 0 0	(+)50 0 0	(a)
			..	..	184. Improvement of Ber fruit trees, Pepsu.	2,800 0 0	(—)2,800 0 0	(x)
			2,000	2,000	185. Fruit preservation, M.P.	2,000 0 0	..	
			..	600	186. Preparation of a manual of fruit culture in India, Punjab.	512 0 0	(+)88 0 0	(a)

(c) *Vegetables*

..	400	187.	Tuber crops, Bombay	355 0 0	(+)45 0 0	(a)
1,800	100	188.	Do. Punjab .	10 0 0	(+)90 0 0	(a)
2,300	6,700	189.	Do. Bihar .	6,700 0 0	..	
4,000	3,500	190.	Do. Orissa .	3,450 0 0	(+)50 0 0	(a)
8,000	5,500	191.	Do. Madras .	5,410 0 0	(+)90 0 0	(a)
3,150	3,500	192.	Do. Andhra .	3,465 0 0	(+)35 0 0	(a)
6,500	6,000	193.	Do. and related plants, T. University.	6,000 0 0	..	
26,500	22,000	194.	Tapioca and Sweet Potato, Travancore-Cochin.	21,971 2 8	(+)28 13 4	(a)
9,500	9,900	195.	Improvement of vegetables, Bombay.	9,804 0 0	(+)96 0 0	(a)
14,900	16,900	196.	Do. U.P. .	16,896 0 0	(+)4 0 0	(a)
10,760	9,800	197.	Do. Pepsu .	9,800 0 0	..	
12,700	11,200	198.	Do. Madras .	11,149 1 0	(+)50 15 0	(a)
10,800	9,900	199.	Do. Kashmir .	9,900 0 0	..	
7,200	5,700	200.	Do. Punjab .	5,700 0 0	..	
9,900	10,300	201.	Do. West Bengal	10,243 10 0	(+)56 6 0	(a)
9,000	14,500	202.	Do. M.P. .	14,500 0 0	..	
6,700	5,900	203.	Do. V.P. .	5,860 0 0	(+)40 0 0	(a)
7,700	8,300	204.	Do. H.P. .	8,300 0 0	..	

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.	Rs. a. p.	
			..	200	205. Potato Breeding and Intermagnate Station for Potato Breeding, I.D.R.I.	107 5 0	(+)92 11 0	(a)
			..	4,300	206. Co-ordinated scheme on the effect of chemicals on the storage of fruits and vegetables, Madras.	4,270 0 0	(+)30 0 0	(a)
					(f) *Other Crops*			
			3,600	4,000	207. Ergot production, Assam.	3,940 0 0	(+)60 0 0	(a)
			1,500	5,900	208. Turmeric, Orissa .	5,870 0 0	(+)30 0 0	(a)
			15,800	11,900	209. Pepper, Madras .	11,900 0 0	..	
			..	2,600	210. Chillies, Madras .	2,590 0 0	(+)10 0 0	(a)
			..	1,800	211. Cloves, Travancore	1,762 0 0	(+)38 0 0	(a)
			1,700	1,700	212. Zira diseases, Rajasthan.	1,650 0 0	(+)50 0 0	(a)
			11,200	6,000	213. Medicinal Plants, Assam.	6,000 0 0	..	
			21,300	8,800	214. Do. F.R.I. .	8,770 0 0	(+)30 0 0	(a)
			10,700	11,100	215. Do. Kashmir .	11,040 0 0	(+)60 0 0	(a)
			11,500	4,500	216. Do. West Bengal	14,460 0 0	(-)9960 0 0	(x)
			5,300	3,000	217. Turmeric, Andhra.	3,000 0 0	..	

5,900	4,000	218. Ginger, Assam .	4,000 0 0	..		
7,300	4,300	219. Chillies, Andhra .	4,226 0 0	(+)74 0 0	(a)	
3,300	5,600	220. Ergot production, West Bengal.	5,510 0 0	(+)90 0 0	(a)	
..	1,800	221. Investigation of insect infestation of pepper exported to U.S.A., Madras.	1,750 0 0	(+)50 0 0	(a)	
..	7,800	222. Foorkie disease of cardamom, West Bengal.	7,790 0 0	(+)10 0 0	(a)	
		(g) *Soil and Manures*				
..	8,700	223. Control of erosion, Visva Bharati Institute.	8,601 0 0	(+)99 0 0	(a)	
12,000	10,000	224. Soil standardisation method, Bombay.	10,000 0 0	..		
5,100	3,900	225. Soil and plant growth, Agra.	3,840 0 0	(+)60 0 0	(a)	
4,300	2,700	226. Nitrogen fixation in soils, M.P.	2,628 0 0	(+)72 0 0	(a)	
19,000	2,200	227. Soil conservation, H.P.	2,160 0 0	(+)40 0 0	(a)	
1,200	13,200	228. Nitrogen fixation in soils, Sheila Dhar Institute.	13,200 0 0	..		
3,220	7,700	229. Rapid Soil Test, I.A.R.I.	7,640 0 0	(+)60 0 0	(a)	

APPENDIX XIII—(*Contd.*)

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.	Rs. a. p.	
			1,960	20,000	230. Manurial experiments, Bombay.	20,000 0 0	..	
			1,350	24,900	231. Do. Pepsu .	24,870 0 0	(+)30 0 0	(a)
			560	4,800	232. Do. W. Bengal.	4,714 13 5	(—)85 2 7	(a)
			1,920	15,000	233. Do. Bihar .	15,000 0 0	..	
			1,600	14,900	234. Do. Punjab .	14,900 0 0	..	
			2,460	47,000	235. Do. Bhopal .	47,000 0 0	..	
			3,800	3,200	236. Green manuring crops, Bihar.	3,110 0 0	(+)90 0 0	(a)
			7,900	7,000	237. Do. C.R.R.I. .	6,978 0 0	(+)22 0 0	(x)
			8,700	4,000	238. Do. I.C.J.C. Calcutta.	4,000 0 0	..	
			3,600	2,600	239. Do. H.P.	2,526 0 0	(+)74 0 0	(a)
			2,800	2,000	240. Do. Mysore .	2,000 0 0	..	
			7,200	6,000	241. Micro-nutrient status of soils, Bombay.	6,000 0 0	..	
			1,200	13,200	242. Usar land reclamation, Sheila Dhar Institute.	13,200 0 0	..	
			21,900	19,400	243. Studies in microflora of soils, I.I.Sc. Bangalore.	19,306 0 0	(+)94 0 0	(a)

2,400	2,100	244.	Azotobacter inoculation of crops, West Bengal.	2,100	0	0	..			
			(h) *Agronomy*							
3,600	3,200	245.	Phenological Observations, Poona.	3,126	0	0	(+)74	0	0	(a)
11,000	20,700	246.	Water requirements of crops at Central Field Research Station, Poona.	20,650	0	0	(+)50	0	0	(a)
..	100	247.	Chemistry of malting Cholam, Madras.	73	12	0	(+)26	4	0	(a)
..	300	248.	Supplement to the monograph on Dry Farming in India, Bombay.	250	0	0	(+)50	0	0	(a)
..	12,000	249.	Model Agronomic Experiments, Other Centres.	12,000	0	0	..			
			(i) *Physiology*							
..	2,100	250.	Wheat physiology, Delhi University.	2,100	0	0	..			
..	6,400	251.	Plant physiology, Shri Boshi Sen, Almora, U.P.	6,382	7	5	(+)17	8	7	(a)
3,200	3,330	252.	Cytological studies on crop plants, Andhra University.	3,300	0	0	(+)30	0	0	(a)

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.	Rs. a. p.	
			10,000	20,300	253. Use of Physiohormones for higher yields, Bombay.	20,230 0 0	(+)70 0 0	(a)
			10,000	7,500	254. Chemical stimulation of ovules, Delhi University.	7,480 0 0	(+)20 0 0	(a)
			10,700	53,000	255. Plant physiology and plant introduction, U.P.	52,980 11 6	(+)19 4 6	(a)
			..	460	256. Sub-station of plant introduction bureau, U.P.	459 8 0	(+) 0 8 0	(a)
					(j) *Entomology*			
			..	400	257. Schools of research entomology, Aligarh	396 0 0	(+)4 0 0	(a)
			..	2,800	258. Weed Control, M.P.	2,800 0 0	..	
			...	4,800	259. Do. Bhopal .	4,794 0 0	(+)6 0 0	(a)
			..	5,000	260. Do. H.P. .	5,000 0 0	..	
			..	2,200	261. Do. M. Bharat	2,200 0 0	..	
			..	2,700	262. Do. Andhra .	2,700 0 0	..	
			1,970	12,700	263. Do. Poona	12,654 0 0	(+)46 0 0	(a)
			70	3,000	264. Do. Madras .	3,000 0 0	..	
			1,500	15,000	265. Do. W. Bengal (Bose Inst.)	15,000 0 0	..	

13,200	5,400	266.	Termite Research, F.R.I.	5,390	0	0	(+)10	0	0	(a)
3,310	6,700	267.	Do. I.A.R.I.	6,700	0	0	..			
2,400	1,800	268.	Do. Anand Institute.	1,730	0	0	(+)70	0	0	(a)
..	100	269.	Research on insecticides, Punjab.	51	12	0	(+)48	4	0	(a)
2,600	3,600	270.	Tests with D.D.T., Bombay.	3,600	0	0	..			
			(k) *Mycology*							
29,200	30,700	271.	Virus diseases, Poona	30,684	0	0	(+)16	0	0	(a)
12,300	12,000	272.	Do. Simla	12,000	0	0	..			
8,300	8,000	273.	Do. Delhi	8,000	0	0	..			
..	..	274.	Mycological and Entomological Investigation, U.P.	9	0	0	(—)9	0	0	(a)
			(l) *General*							
30,500	22,400	275.	Introduction of new economic plants, I.A.R.I.	22,393	6	6	(+)6	9	6	(a)
1,660	200	276.	Pre-soaking seeds in nutrient salts, Madras.	200	0	0	..			
10,500	7,400	277.	Mechanism of polyploidy, Indore.	7,400	0	0	..			

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.	Rs. a. p.	
					(ii) Animal Husbandry			
					(a) *Cattle Breeding*			
			25,950	9,800	278. Livestock investigation Punjab.	9,744 8 0	(+)55 8 0	(a)
			42,600	42,000	279. Improvement of Kangayam breed of cattle, Madras.	42,000 0 0	..	
			19,560	19,500	280. Evolving suitable draught-capacity measure for bullocks, I.V.R.I.	19,500 0 0	..	
			26,000	24,000	281. Selective breeding and grading up of indigenous cattle, Orissa.	24,000 0 0	..	
			6,910(g)	5,700	282. Metabolic effects of hormones in relation to induced lactation, U.P.	5,700 0 0	..	
			32,000	12,600	283. Physiological Genetics of Cattle, West Bengal.	12,503 2 0	(+)96 14 0	(a)
			..	16,000	284. Selective breeding and grading up of cattle, Orissa.	16,000 0 0	..	
			43,800	4,400	285. Artificial inoculation, I.D.R.I.	4,361 14 0	(+)38 2 0	(a)

38,400	8,000	286.	Co-ordinated Cattle Sterility, I.V.R.I.	8,000	0	0	..			
14,000	5,600	287.	Do. Madras .	5,600	0	0	..			
18,860	10,800	288.	Do. Bombay .	10,800	0	0	..			
16,620	15,000	289.	Do. U.P. .	15,000	0	0	..			
15,140	10,000	290.	Do. Bihar .	10,000	0	0	..			
10,440	18,000	291.	Cross breeding of Cattle, Andhra.	18,000	0	0	..			(a)
11,500	16,300	292.	Do. Madras .	16,211	0	0	(+)89	0	0	(a)
10,620	100	293.	Do. Assam .	8	7	0	(+)91	9	0	(a)
11,120	24,100	294.	Do. Bihar .	24,050	0	0	(+)50	0	0	(a)
14,000	18,300	295.	Do. Punjab.	18,240	0	0	(+)60	0	0	(a)
23,600	23,200	296.	Do. Travancore-Cochin.	23,200	0	0	..			
..	17,900	297.	Do. Manipur	17,900	0	0	..			
			(b) *Goat & Sheep Breeding*							
..	..	298.	Development of mutton breeds of sheep, Bombay.	342	0	0	(-)342	0	0	(x)
5,710	200	299.	Goat Breeding, Punjab.	105	2	3	(+)94	13	9	(a)
9,480	8,000	300.	Sheep Research Station, Punjab.	8,000	0	0	..			

1	2	3	4	5		6	7		8		9
			Rs.	Rs.			Rs. a. p.		Rs. a. p.		
			15,900	16,900	301.	Sheep and wool improvement on regional basis, U.P.	16,895 0 0		(+) 5 0 0		(a)
			36,090	10,400	302.	Do. Bombay (Joria Centre)	10,366 0 0		(+)34 0 0		(a)
			4,970	5,700	303.	Do. Bihar .	5,635 6 8		(+)64 9 4		(a)
			7,940	7,100	304.	Do. Madras .	7,051 12 4		(+)48 3 8		(a)
			13,420	10,000	305.	Do. Rajasthan	10,000 0 0		..		
			24,800	9,700	306.	Do. H.P. .	9,700 0 0		..		
			10,150	2,200	307.	Do. Jammu & Kashmir.	2,125 0 0		(+)75 0 0		(a)
			..	12,020	308.	Do. Bombay .	12,000 0 0		(+)20 0 0		(a)
			..	2,100	309.	Soil Analysis on Sheep Breeding, J. K., I.A.R.I.	2,100 0 0		..		
			..	10	310.	A.D.I. (Sheep) Bihar	5 4 0		(+)4 12 0		(a)
						(c) *Animal Nutrition*					
			79,230	1,01,300	311.	Animal Nutrition, Bombay.	1,01,300 0 0		..		
			41,590	20,100	312.	Do. I.D.R.I. .	20,084 0 0		(+)16 0 0		
			11,270	20,100	313.	Do. West Bengal	19,920 0 0		(+)180 0 0		

32,000	9,000	314.	Utililzation of waste products for feeding of cattle, Orissa.	9,000 0 0	..	
58,380	100	315.	Further work on paddy straw.	14 0 0	(+)86 0 0	(a)
..	1,000	316.	Standardisation of rations for ryots, cattle, Orissa.	922 0 0	(+)78 0 0	(a)
			(d) *Animal Pests & Diseases & Cure*			
4,150	2,800	317.	Veterinary Investigation Officer(cattle) Travancore Cochin.	2,730 0 0	(+)70 0 0	(a)
..	9,000	318.	Do. Assam. .	8,985 0 0	(+) 15 0 0	(a)
4,880	3,000	319.	Do. Pepsu.	3,000 0 0	..	
12,150	6,000	320.	Do. Rajasthan .	6,000 0 0	..	
8,040	3,500	321.	Do. Mysore .	3,500 0 0	..	
..	900	322.	I.V.O. (Sheep & Goats) Madras.	832 0 0	(+)68 0 0	(a)
4,120	4,000	323.	Do. Hyderabad	3,956 2 7	(+) 43 13 5	(a)
5,840	4,700	324.	Do. U.P. .	4,700 0 0	..	
54,640	6,000	325.	Tuberculosis & Johne's disease among animals, I.V.R.I.	5,936 0 0	(+)64 0 0	(a)

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.	Rs. a. p.	
			31,210	100	326. Helminth parasites, I.V.R.I.	9 0 0	(+)91 0 0	(a)
			13,070	12,800	327. Parasitic disease, Mysore.	12,800 0 0	..	
			5,730	4,000	328. Fluke disease of bovines, Bombay.	4,000 0 0	..	
			14,680	8,000	329. Investigation of infectious abortion (Brucellosis), U.P.	8,000 0 0	..	
			4,600	3,900	330. Control and eradicating of stephanofil cases among cattle, Orissa.	3,880 0 0	(+)20 0 0	(a)
			10,480	4,400	331. Do. Assam 332. Do. W. Bengal	4,350 0 0	(+)50 0 0	(a)
			..	5,500	333. Tuberculin testing, Madras.	5,500 0 0	..	
			20,350	11,000	334. Bearing of nutrition on helminthic infection, I.V.R.I.	11,000 0 0	..	
			29,020	24,300	335. Control of bovine pleuro-pneumonia, Assam.	24,216 0 0	(+)84 0 0	(a)
			9,240	6,500	336. Contagious caprine pleuro-pneumonia I.V.R.I.	6,450 0 0	(+)50 0 0	(a)
			7,000	4,400	337. Lumbar paralysis in goats, Orissa.	4,400 0 0		

6,450	4,100	338.	Investigation of mastitis, Bombay.	4,884 12 0	(+)15 4 0	(a)
8,470	12,600	339.	Do. I.V.R.I. .	12,600 0 0	..	
1,500	4,000	340.	Do. Punjab .	4,000 0 0	..	
4,000	3,100	341.	Do. Mysore .	3,100 0 0	..	
			(e) *Dairying*			
..	14,000	342.	Study on development dairy for use in organised village milk-producing and milk-handling trends, I.D.R.I.	14,000 0 0	..	
..	16,000	343.	Scheme for the study of pasteurisation of milk in relation to destruction of Polyghnic bacteria, I.D.R.I.	16,000 0 0	..	
..	5,000	344.	Survey of bacteriological quality of market milk, I.D.R.I. Lucknow.	23 10 0	(+)26 6 0	(a)
22,600	17,000	345.	Production of dehydrated powder & edible casein, I.D.R.I.	17,000 0 0	..	
			(f) *Wool*			
1,930	2,400	345A.	Wool Analysis, Bihar.	2,400 0 0	..	
..	6,700	346.	Cost of production of sheep & wool, Poona.	6,670 2 6	(+)29 13 6	(a)

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.		
					(g) *Skins & Hides*			
			20,310(k)	18,000	347. Chemistry of mineral tannages, C.L.R.I.	18,000 0 0	..	
			12,390	15,800	348. Manufacture of fat liquors, C.L.R.I.	15,800 0 0	..	
			8,000	7,000	349. Manufacture of chrome retan leather, C.L.R.I.	7,000 0 0	..	
			3,540	5,700	350. Manufacture of leather boards, C.L.R.I.	5,680 0 0	(+)20 0 0	(a)
					(h) *Poultry*			
			4,260	3,000	351. Influence of climate on performance of *desi* fowl, Orissa.	3,000 0 0	..	
			..	4,000	352. Laying trials of poultry, I.V.R.I.	4,000 0 0	..	
			7,600	1,000	353. Coccidiosis in Poultry, I.V.R.I.	1,000 0 0	..	
			..	4,700	354. Poultry, research M.P.	4,674 0 0	(+)26 0 0	(a)
			9,900	7,400	355. Do. Travancore Cochin.	7,400 0 0	..	
			5,900	3,200	356. Immunization of village poultry against Ranikhet disease, Bombay.	3,200 0 0	..	

2,430	4,300	357.	Helminth parasites affecting poultry, I.V.R.I.	4,300 0 0	..	
5,240	3,500	358.	Duck breeding, Travancore-Cochin.	3,420 0 0	(+)80 0 0	(a)
			(i) *Fish*			
..	3,300	359.	Piscicultural Research Annamalai Uty.	3,256 0 0	(+)44 0 0	(a)
6,300	5,200	360.	Processing of unpopular fish, W. Bengal.	5,200 0 0	..	
6,700	3,900	361.	Fish fauna and ecology of food fishes.	3,870 0 0	(+)30 0 0	(a)
8,040	5,600	362.	Regional Bee-research Station—Madras.	5,585 1 6	(+)14 14 6	(a)
			(j) *Miscellaneous*			
..	5,400	363.	Using cow for work, I.V.R.I.	5,400 0 0	..	
4,330	2,400	364.	Post-graduate course in parasitology—Madras.	2,400 0 0	..	
			(iii) Combined Agriculture and Animal Husbandry Schemes			
..	4,200	365.	Village projects, Bombay (Baroda).	4,195 0 0	(+) 5 0 0	(a)

APPENDIX XIII—(*Contd.*)

1	2	3	4	5	6	7	8	9
			..	Rs. 7,100	366. Production and trial of Agricultural Implements.	Rs. a. p. 7,020 0 0	Rs. a. p. (+)80 0 0	(a)
			7,000	2,900	367. Refresher Course in Agri. for young farmers, Madras & Andhra.	2,900 0 0	..	
			..	1,100	368. Do. Amravati .	1,030 0 0	(+)70 0 0	(a)
			..	7,600	369. Do. Hyderabad	7,600 0 0	..	
			..	600	370. Training Centres on Japanese method of paddy cultivation —Bombay.	550 0 0	(+)50 0 0	(a)
			6,000	2,800	371. Institution of junior & senior fellowships for post graduate and Ph.D. degree in various agricultural sciences. Various centres.	2,744 8 0	(+)55 8 0	(a).
			..	12,400	372. Survey of indigenous implements. Madras.	12,390 0 0	(+)10 0 0	(a)
			..	13,000	373. Do. U.P. .	13,000 0 0	..	
			..	8,800	374. Do. Punjab .	8,760 0 0	(+)40 0 0	(a)
			..	13,000	375. Do. Bombay .	13,000 0 0	..	

..	17,000	376.	Survey of indigenous implements, Assam.	17,000	0	0	..		
..	4,800	377.	Do. M.P.	4,800	0	0	..		
..	7,300	378.	Do. W. Bengal	7,300	0	0	..		
..	9,800	379.	Do. Orissa	9,780	0	0	(+)20	0	0 (a)
..	1,900	380.	Do. Hyderabad	1,850	0	0	(+)50	0	0 (a)
..	4,640	381.	Do. M.B.	4,640	0	0	..		
..	10,000	382.	Do. Mysore	10,000	0	0	..		
..	16,000	383.	Do. Rajasthan	16,000	0	0	..		
..	3,400	384.	Do. Travancore-Cochin.	3,400	0	0	..		
..	1,700	385.	Do. Pepsu	1,700	0	0	..		
..	300	386.	Do. Bhopal	226	0	0	(+)74	0	0 (a)
..	7,000	387.	Do. Coorg	7,000	0	0	..		
..	18,300	388.	Do. V.P.	18,290	0	0	(+)10	0	0 (a)
2,170	2,100	389.	Training of village blacksmith, Hyderabad.	2,100	0	0	..		
..	500	390.	Commercial production of ovules, Delhi Universitv.	428	0	0	(+)72	0	0 (a)

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.		
					(iv) Miscellaneous Schemes			
			7,120	10,300	391. Nature & extent of non-farm employment in rural areas of Gujrat in Bombay State, Bombay.	10,300 0 0	..	
			..	6,000	392. Livestock & Fisheries Statistics, Travancore-Cochin.	6,000 0 0	..	
			..	200	393. Do. Bihar .	137 8 0	(+)62 8 0	(a)
			..	24,000	394. Do. Bombay .	24,000 0 0	..	
			4,000	2,000	395. Award of research fellowship for the economics of multi-purpose river valley projects in India, Delhi.	2,000 0 0	..	
			28,600	28,600	396 { Commonwealth Agriculture Bureaux. Imperial Institute of Mycology. Imperial Institute of Entomology. Farnham House Laboratory. Imperial Bureaux of Dairy Science. Fruit Preservation Research Station, Campden. }	28,560 0 0	(+)40 0 0	(a)

..	5,000	397.	Drought resistant strains of paddy, Madras.	4,930	0	0	(+)70	0	0	(a)	Rice.
..	5,700	398.	Rice Physiology, Calcutta University.	5,650	0	0	(+)50	0	0	(a)	
..	6,000	399.	Deep-water paddy, Andhra.	6,000	0	0	..				
..	2,400	400.	Rice stem borer—Madras.	2,340	0	0	(+)60	0	0	(a)	
..	9,190	401.	Do. West Bengal	9,080	0	0	(+)110	0	0	(a)	
..	3,500	402.	Do. Andhra	3,440	0	0	(+)60	0	0	(a)	
..	2,400	403.	Stem-rot disease of rice, Madras.	2,372	8	0	(+)27	8	0	(a)	
..	9,800	404.	Hybrid Maize, Bombay.	9,800	0	0	..				
..	6,000	405.	Disease of bajra, Anand Institute.	6,000	0	0	..				
..	400	406.	Blast Foot disease—Madras.	379	10	0	(+)20	6	0	(a)	
..	3,100	407.	Alkali reclamation, Andhra.	3,100	0	0	..				
..	2,300	408.	Legume Seed inoculation Andhra.	2,220	0	0	(+)80	0	0	(a)	

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		R. a. p.	R. a. p.	
			..	1,500	409. Research on Cashewnut, Andhra.	1,450 0 0	(+)50 0 0	(a)
			..	4,000	410. Cytogenetical Investigation of fruit trees, Cal. Uty.	4,000 0 0	.	
			..	1,300	411. Chillies Research Scheme, I.A.R.I.	1,300 0 0	..	
				3,300	412. Spices Scheme, W. Bengal.	3,300 0 0	..	
				3,000	413. Clove nuturegated coca Scheme Madras.	3,000 0 0	..	
			..	6,700	414. Botanical mprovement of essential oils, I. A. R. I.	6,700 0 0	..	
			.	5,600	415. Co-ordinated plant virus scheme, Eastern Zone, I.A.R.I.	5,600 0 0	..	
			.	11,800	416. Survey of Indigenous Agriculture Implements, Andhra.	11,740 0 0	(+)60 0 0	(a)
			..	8,000	417. Model Agronomic Experiments, Madras.	8,000 0 0	..	
			.	10,000	418. Do. PEPSU	10,000 0 0	..	
			..	7,000	419. Do. Punjab	7,000 0 0	..	

..	8,000	420.	Do. M. Bharat.	8,000	0	0	..			
..	10,000	421.	Do. Andhra .	10,000	0	0	..			
..	10,000	422.	Do. Travancore-Cochin.	10,000	0	0	..			
..	4,000	423.	Sugarcane Production, Andhra.	4,000	0	0	..			
..	1,100	424.	Do. Pepsu. .	1,100	0	0	..			Misc.
..	4,000	425.	Do. Bombay .	4,000	0	0	..			Do.
..	800	426.	Do. Madras .	800	0	0	..			Do.
..	4,500	427.	Do. Punjab .	4,500	0	0	..			Do.
..	2,900	428.	Do. Hyderabad	2,900	0	0	..			Do.
..	3,500	429.	Do. M.B. .	3,500	0	0	..			Do.
..	13,500	430.	Pilot sample survey-pepper, Madras.	13,420	0	0	(+)80	0	0	Do.
..	13,100	431.	Do. Travancore Cochin.	13,090	0	0	(+)10	0	0	Do.
..	30,000	432.	Development of pepper, Madras.	30,000	0	0	..			Other Crops.
..	2,600	433.	Cashewnut, M.B. .	2,600	0	0	..			Fruits.
..	2,900	434.	Pulse breeding, M.B. (Gwalior).	2,835	0	0	(+)65	0	0	(a) Millets & Pulses.
..	3,900	435.	Survey of fertilizer practices, Bihar.	3,900	0	0	..			Soils and Manure.

1	2	3	4	5	6	7	8	9
			Rs.	Rs.		Rs. a. p.	Rs. a. p.	
			..	10,000	436. Scheme on Method and Practices of Farm Accounts, Bose Institute of Politics, Poona.	10,000 0 0	...	Soils and Manure.
			..	36,000	437. Selective breeding and grading up of cattle—W. Bengal.	36,000 0 0	..	(a) Cattle Breeding.
			..	6,100	438. Physiological norms of Indian Cattle, W. Bengal.	6,090 0 0	(+)10 0 0	Do.
			..	6,000	439. Goat Breeding U.P.	6,000 0 0	..	(b) Govt.
			..	8,200	440. Goat Improvement W. Bengal.	8,120 0 0	(+)80 0 0	(a).
			..	25,700	441. Nutrition requirements of buffaloes, Agra.	25,700 0 0	—	
			..	2,200	442. Study of the bacteriological flora in bovines and their treatment and control, Orissa.	2,200 0 0	..	(d)
			..	3,600	443. Detection of adulteration and estimation of main constituents of milk, Punjab Uty.	3,600 0 0	..	(d)

..	31,900	444.	Bacteriological quality of milk, Kaira, Distt. Anand.	31,870	0	0	(+)30	0	0	(a)		
..	2,000	445.	I.D.I.O. Poultry—Andhra.	2,000	0	0	..			(b)		
..	46,000	446.	Poultry development, American Mission, Madras.	45,958	0	0	(+)42	0	0	(a)	(b)	
..	58,000	447.	Do. Travancore-Cochin.	58,000	0	0	..			(b)		
..	9,000	448.	Improvement in craft and tackle for inland and esturine fishing, Orissa.	9,000	0	0	..					
..	5,000	449.	Pilot survey in inland fisheries—Hyderabad.	5,000	0	0	..			Misc.		
				2,39,538	0	0						

1	2	3	4	5	6	7	8	9
					C. Debts and Remittances.			
			Rs.	Rs.		Rs. a. p.		(a) Inconsiderable.
					(I) Loans and Advances			
			3,000	6,900	Advances paid to the Staff for the purchase of cycles, motor cycles and motor cars.	6,820 0 0	(+)80 0 0	(a).
						Rs. a. p.		
					(II) Deposits and Advances Repayable			
					(a) *Deposits of I. C. A. R. Provident Fund.*—			
					(i) Advances from subscription .	10,629 0 0		
					(ii) Repayment of subscription .	22,931 9 0		
					(iii) Repayment of Council's Contribution.	7,813 0 0		
					(iv) Payment of interest . . .	1,726 13 0		
					(v) Suspense	..		
					(vi) Miscellaneous	0 1 0	10,115 9 3	(+)784 6 9 (a).
			1,00,000	10,900	(b) *Other Deposits and Advances Repayable.*—			
					(i) Library Deposit	..		
					(ii) Permanent Advance. . . .	..		
					(iii) Caution money repayable . .	..		
					(iv) Suspense . . . . (—)	33,196 12 9		
					(v) Other Deposits and Advances .	211 15 0		

(c) *Payment of Income-tax Provident Fund etc.*

		(i) Income tax	4,271 3 0			
		(ii) G. P. Fund	4,296 0 0			
		(iii) Contributory Provident Fund	231 9 0			
		(iv) Miscellaneous Recoveries	6,811 8 0			
		(v) Postal Life Insurance	126 0 0			
36,790	24,00	(vi) Payment of I.C.A.R. Provident Fund	7,792 1 8	23,528 5 8		
		TOTAL EXPENDITURE		53,86,619 10 0	(+)471 10 4	(a).
		Investment and re-investment		45,70,000 0 0		
		Repayment of unspent balances		68,606 9 10		
		Closing balances :—				
		(i) Cash in hand	14,171 2 9			
		(ii) Bank	12,32,425 8 7			
		(iii) Provident Fund	35,190 7 5	12,81,787 2 9		
				113,07,013 7 3		

Verified and found correct.
(Sd.) I. S. SHARMA,
Asstt. Accounts Officer.

Attested true copy
(Sd.) N. BOSE,
15-5-57.
Supdt./OAD/(C).

AJUDHIA PRASADA,
Under Secretary.

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